Instruction Manual

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MODEL

1941A

DIGITAL COUNTER

FLUKE®

JOHN FLUKE mfg. co., inc.

SEATTLE, WASHINGTON

JOHN FLUKE MFG. CO., INC.
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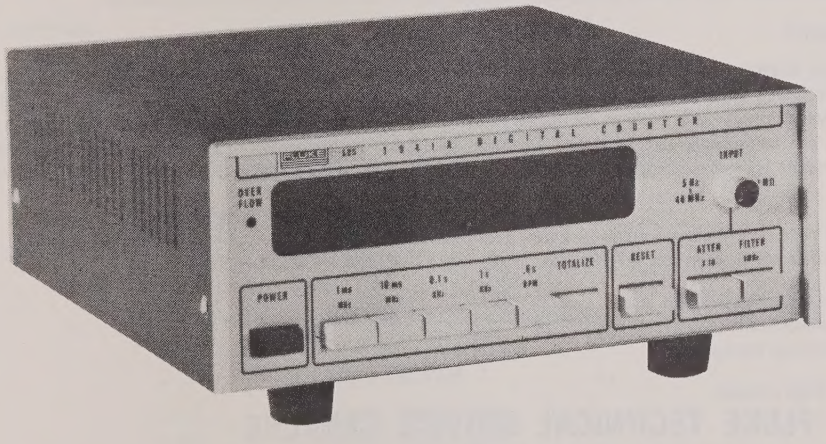
Seattle, Washington 98133



MODEL

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MARCH 1974

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Section 1
Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 1941A is a rugged, high-speed, multi-function counter designed for industrial and general purpose use. The counter may be used to measure frequencies in the range of 5 Hz to 40 MHz, to count and totalize external events to a total of 999999 plus overflow indicator, and to indicate revolutions per minute when used in conjunction with a 5 to 4.0 x 10^7 pulse/second tachometer. In addition, the counter is equipped with a selectable 1 MHz filter and a 10:1 attenuator to permit reliable operation in electrically noisy environments. With the 1 MHz selected, frequency response is limited to 5 Hz to 1 MHz. With the attenuator selected, input sensitivity is 400 mVrms. With the attenuator not selected, input sensitivity is 40 mVrms.

1-3. Frequency, range and function selections are made by means of pushbutton switches. Frequency, total and rpm values are displayed by six gas-discharge tubes. The counter input is a front-panel mounted BNC connector and has an impedance of one megohm shunted by 30pf.

1-4. The rear panel provides an external timebase input which will accept a 10 MHz signal of 500 mVrms or greater. The rear panel also contains slide switches to select either the external or internal timebase, and to select either 115-volt or 230-volt ac primary power.

1-5. OPTIONS AND ACCESSORIES

1-6. The Model 1941A is available with the –02 Option, BCD Output and the –05 Option, BCD Preset Input. The –02 Option provides a rear panel output of the counter display, coded in BCD format, for use by external recording or display equipment. The –05 Option provides a rear panel input connector which accepts BCD data to offset the counter display to any desired value prior to measurement. The –05 Option is used to offset the counter display to some value, which when added to the measured value, results in a reading of all zeroes plus an overflow indication on the counter display. Additional option information is contained in Section 6 of this manual.

1-7. The Model 1941A may be bench-mounted and is equipped with a tilt bail to provide convenient positioning of the instrument. The counter may also be mounted in a standard 19-inch equipment rack when equipped with a rack mounting hardware accessory. Additional rack mounting details are provided in Section 6 of this manual.

1-8. SPECIFICATIONS

FREQUENCY RANGE	5 Hz to 40 MHz (filter out) 5 Hz to 1 MHz (filter in)
INPUT SENSITIVITY	
Sine Wave	40 mV rms (attenuator out) 400 mV rms (attenuator in)
Pulse	150 mV p-p (attenuator out) at minimum pulse width of 15 nsec with > 10% duty cycle 1.5V p-p (attenuator in)
INPUT IMPEDANCE	1MΩ shunted with less than 30pF (with filter out)
OVERLOAD CAPABILITY	150V rms for frequencies up to 1 kHz, decreasing to 5V rms (attenuator out), or 50V rms (attenuator in) at 40 MHz. DC + peak ac not to exceed 250V.
GATE TIMES	1 msec, 10 msec, 100 msec, and 1 sec (RPM gate time 600 ms)
TOTALIZING	Counts to 999999, then activates overflow indicator
READOUT	6 digit in-line display incorporating long-life gas-discharge tubes. LED overflow indicator.
DISPLAY TIME	200 msec plus gate time
TIME BASE	
Aging Rate	6×10^{-7}/day, 2×10^{-6}/month
Temperature Dependence	1×10^{-6} (20°C to 30°C) 5×10^{-6}(0°C to 40°C)
Line Voltage Dependence (±10% Change)	2×10^{-7}
EXTERNAL TIMEBASE INPUT	
Frequency	10 MHz
Sensitivity	500 mV rms
Impedance	20k shunted with 50 pF
OPTIONAL BCD OUTPUT AND BCD OFFSET	4 line 8-4-2-1 offset to each digit TTL compatible, high true. Fanout is 8 54/74 loads for the BCD output.
STORAGE TEMPERATURE RANGE	−40°C to +75°C
OPERATING TEMPERATURE RANGE	0°C to +40°C
POWER REQUIREMENTS	115V rms ±10% or 230V rms ±10% (switchable) 50 – 60 Hz (100V available upon request), 14 watts.
FUSE	1 Amp (115V) or ½ Amp (230V)
DIMENSIONS	3" High – 7.6 cm 7½" Wide – 19.05 cm 9¼" Deep – 23.5 cm
WEIGHT	6 Pounds – 2.7 kg

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section contains operating instructions for the Model 1941A Digital Counter. It is recommended that the contents of this section be read and understood before any attempt is made to operate this instrument. Operating instructions for options and accessories are provided in Section 6. Should any difficulties be encountered, please contact your nearest John Fluke Sales Representative or the John Fluke Mfg. Co., Inc., P.O. Box 7428, Seattle, Washington 98133, Telephone (206) 774-2211, or John Fluke Mfg. Co., Ltd., 2247 Midland Ave, Scarborough, Ontario, Canada M1P4R1, Telephone (416) 291-777. A list of Sales Representatives is located at the rear of this manual.

2-3. SHIPPING INFORMATION

2-4. The Model 1941A was packaged and shipped in a cardboard carton. After unpacking the unit a thorough inspection should be performed to reveal any damage that may have occurred in transit.

2-5. If reshipment is necessary, the 1941A should be repackaged in the original container. If the original container is not available, a new one can be obtained from the John Fluke Mfg. Co., Inc. Please reference the Model number (Model 1941A) when requesting a new shipping container.

2-6. INPUT POWER REQUIREMENTS

2-7. The counter may be operated from either 115V rms ±10% or 230V rms ±10%, 50 to 60 Hz line power. A slide switch, located on the rear panel of the unit, selects either the 115 or 230 volt line power requirement.

2-8. OPERATING FEATURES

2-9. The location and function of all front panel controls, connectors, and indicators are shown and described in Figure 2-1 and Table 2-1. The location and function of all rear panel controls and connectors are shown in Figure 2-2 and described in Table 2-2.

2-10. OPERATING NOTES

2-11. The following paragraphs describe various conditions which should be considered prior to operating the Model 1941A.

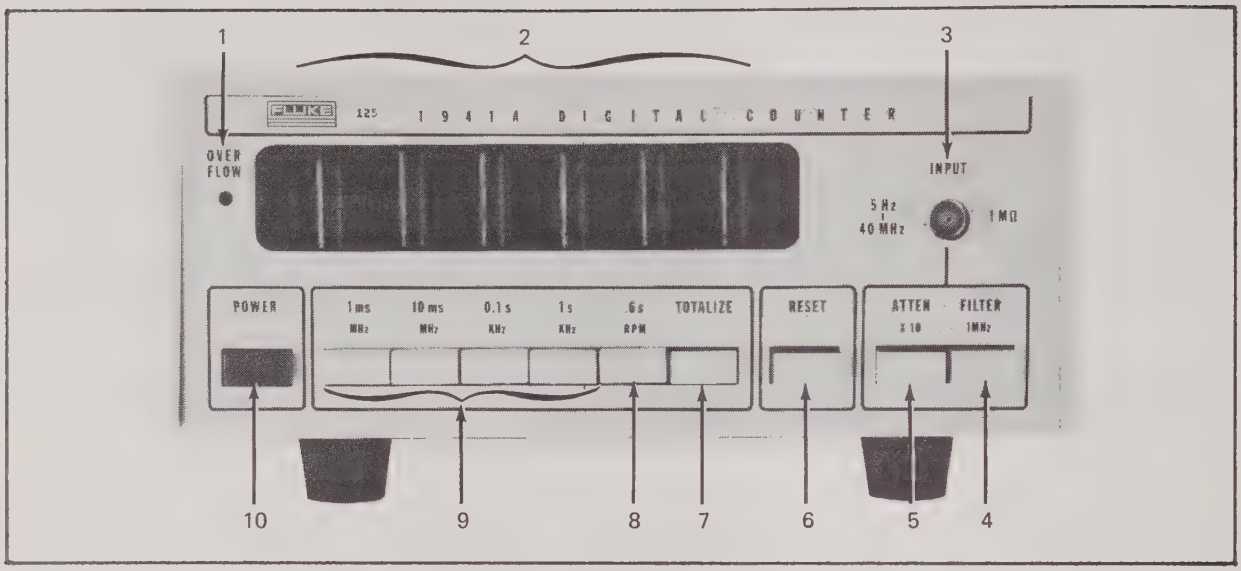

Figure 2-1. FRONT PANEL CONTROLS AND INDICATORS.

Table 2-1. FRONT PANEL CONTROLS AND INDICATORS.

FIG. 2-1 REF. NO.	NAME	FUNCTION
1	OVERFLOW Indicator	Lights to indicate the measurement has exceeded the six-digit display capability.
2	Six gas-discharge display tubes	Indicate the frequency, total or rpm of the signal being measured in digital form.
3	INPUT connector	Provides connection of all measurement signals to the counter.
4	FILTER switch (two-position)	When depressed, inserts a 1 MHz low-pass filter in the input circuit to prevent electrical noise from affecting measurements.
5	ATTENuator switch (two position)	When depressed, attenuates the input signal by a factor of ten.
6	RESET switch (momentary contact)	When depressed, resets the counter six-digit display to all zeroes.
7	TOTALIZE switch (two position)	When depressed, causes the input signals to continuously be counted or totalized.
8	RPM switch (two position)	When depressed, causes the display to indicate revolutions per minutes in units, tens or hundreds, depending upon tachometer resolution.
9	Range switches (two position)	When depressed, selects the indicated range (resolution).
10	POWER switch	When depressed, applies primary power to the instrument.

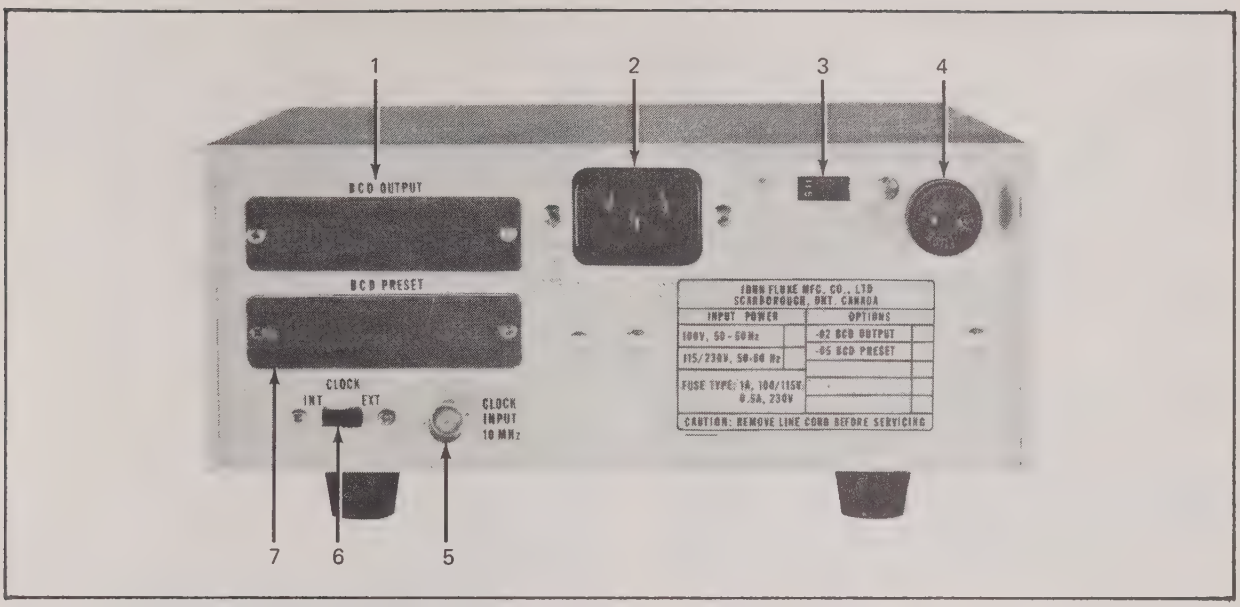

Figure 2-2. REAR PANEL CONTROLS AND INDICATORS.

Table 2-2. REAR PANEL CONTROLS AND CONNECTORS

FIG. 2-2 REF. NO.	NAME	FUNCTION
1	BCD OUTPUT connector 36-pin Amphenol	Provides connection to the –02 Option, BCD Output. Refer to Section 6 for connection details.
2	Power connector	Provides connection of ac power to the unit.
3	115/230 switch	Selects either 115-volt or 230-volt operation
4	Ac power fuse	Provides input power protection (one ampere at 115V and 0.5 amperes at 230V).
5	CLOCK INPUT 10 MHz	Provides for the connection of a 10 MHz external time base signal.
6	INTernal/EXTernal CLOCK selection switch	Selects either the internal timebase or an external 10 MHz time base signal, when connected to the EXT 10 MHz connector. *NOTE!* *The switch must be in the INT position to operate in the frequency and rpm modes when no external 10 MHz time base signal is used.*
7	BCD PRESET connector 36-pin Amphenol	Provides connection for BCD preset inputs. Refer to Section 6 for connection details.

2-12. AC Line Connection

2-13. The input power cord is a three-prong polarized connector and cable which permits connection to a grounded outlet. Ensure that the ground pin is connected to a high quality earth ground. Locate the 115/230-volt selection switch on the rear panel and slide it to the position required for local line voltage, i.e., 115V ac or 230V ac. When the counter is connected to ac line power, the front panel POWER switch is pressed to energize the unit.

2-14. Overload Protection

2-15. The rear panel mounted fuse should be selected in accordance with the local line power voltage. The recommended fuse type is 3AG, with a one-ampere rating for 115V ac applications, and 0.5 amperes for 230V ac applications.

CAUTION!

Do not defeat the purpose of the line power fuse by inserting one of higher current rating than specified for the local line voltage.

2-16. Input Connections

2-17. All signals to be measured are applied to the Model 1941A via the front-panel INPUT connector. The INPUT connector is a BNC-type. A shielded cable assembly equipped with a mating BNC connector should be used for application of the signals to be measured. A second BNC connector is located on the rear panel of the instrument and is used to apply an external timebase signal.

2-18. Input Filter

2-19. The front-panel FILTER switch, when depressed, inserts a 1 MHz low-pass filter in the input of the counter. In this mode, the counter attenuates all signals having frequencies of 1 MHz or greater. The filter is typically used in electrically noisy environments, where erroneous measurements may result when measuring input signals at frequencies less than 1 MHz.

2-20. FUNCTIONAL OPERATION

2-21. The 1941A control settings for each function are outlined in the following paragraphs. The applications for the described functions have been added in order to associate the control settings with a particular counter use.

2-22. Totalize Function

2-23. The 1941A is able to display the total number of cycles of an input signal that occur over any desired length of time. This feature can be used to count the number of cycles of a very low frequency signal or the pulses of a nonrepititous pulse train over any desired period of time. The control settings for this function are as follows:

a. Turn the 1941A on by depressing the POWER button.

b. Push the TOTALIZE button.

c. Connect the signal to be counted to the INPUT jack.

d. The display should be reset to zero to insure a proper count of the input signal. This is done by depressing the RESET button.

2-24. RPM Function

2-25. The counter can be used as a tachometer to digitally display the revolving speed of a 100 pulse per revolution transducer. For transducers having pulse per revolution rates, other than 100, the counter read out is converted to RPM with the formula RPM = readout $X\frac{100}{\text{pulses per rev.}}$ When the RPM function is selected, the counter gate time is set at 0.6 seconds, and the display will not indicate a decimal point. The RPM mode of operation is called by setting the controls as follows:

a. Turn the 1941A on by depressing the POWER switch button.

b. Push the RPM button.

c. Connect the transducer output to the counters INPUT jack.

2-26. Frequency Measurement

2-27. The 1941A counter is capable of digitally displaying inputs within the frequency range of 5 Hz to 40 MHz. The display is in either kHz (two ranges) or MHz (two ranges). The four range (gate time) switches on the front panel control the decimal point location and range of the display. The counter can be set for frequency measurements of input signals as follows:

a. Turn the 1941A on by depressing the POWER button.

b. Select the range (MHz or kHz) that will display the frequency of the expected input signal. If the frequency range of the input signal is not known select the 1 ms gate time. The display capacity increases from 999.999 kHz in the 1s gate time to 040.000 MHz in the 1 ms gate time.

c. Connect the signal to be counted to the INPUT jack.

2-28. External 10 MHz Clock

2-29. An external 10 MHz oscillator can be substituted for the internal oscillator. The output of the external 10 MHz source must be connected to the CLOCK INPUT 10 MHz jack located on the rear panel of the counter, and the CLOCK INT-EXT switch placed in the EXT position.

2-30. BCD Output –02 Option

2-31. The –02 option provides the BCD equivalent of the 1941A display, as an output, to be used for remote indication or recording. When the –02 option is installed, the BCD output is available during any counter function called. Refer to Section 6 of this manual for more information on the –02 option.

2-32. BCD Preset –05 Option

2-33. The –05 option provides a means of offsetting the zero or starting point from which the display counts the cycles of the input signal. The counter display, after measuring the frequency of the input signal, will be equal to the offset plus the frequency of the input signal. Refer to Section 6 of this manual for more information on the –05 option.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual contains the theory of operation for the Model 1941A Digital Frequency Counter. Frequency counter operation in general will be discussed first, with an introduction to the basic block diagram of the 1941A. The individual sections of the block diagram will then be presented in more detail in order to better understand the counter. It is recommended that this section be thoroughly read and understood before an attempt is made to service this instrument.

3-3. GENERAL INFORMATION

3-4. Generally, the frequency of a signal is measured by counting the number of complete cycles of the unknown signal that occur during a known time interval. A digital frequency counter is designed to "sample" the incoming waveform for a precisely controlled length of time and count the number of cycles that occur during this time. The actual count is applied to a "count and display" section where a number of high-speed flip-flops connected in series, decimally count and display the input. A "program logic" section is required to control the repetitive requirements to reset the counters, open the main gate, close the main gate, update the display, and then reset the counters again. The timing of these events is usually controlled by the output of a stable crystal controlled clock.

3-5. Figure 3-1 (1941A Block Diagram) illustrates the relationship of the functional sections of the 1941A counter. The input amplifier accepts the input signal, amplifies and conditions it, then presents it to one input of the main gate. The clock produces a 10 MHz signal which is divided in the clock divider to become the 10 kHz timing signal for the program logic. The program logic uses the 10 kHz to control the opening and closing of the main gate. During the time the main gate is open, the conditioned input signal is allowed to pass through to the count and display section. The count and display section counts the number of cycles of the input signal that pass through the main gate each time it opens, and digitally displays that count as the frequency of the input signal.

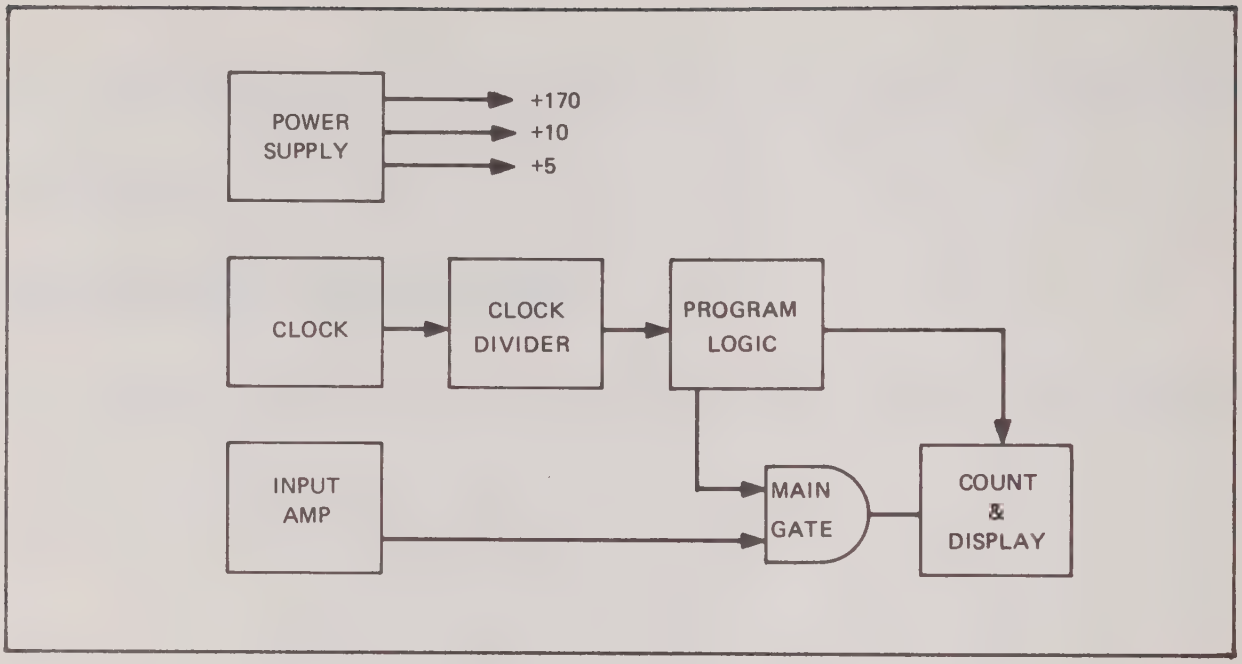

Figure 3-1. 1941A BLOCK DIAGRAM.

3-6. CIRCUIT DESCRIPTION

3-7. Input Amplifier

3-8. The input signal is coupled to the X1/X10 attenuator switch, as shown in Figure 3-2. In the X10 position the level of the input signal is reduced ten times. The input can be filtered to provide for more accurate low frequency readings by depressing the filter switch. The filter limits the high end of the input frequency range to 1 MHz. An input buffer provides broadband frequency coverage with high input impedance. The buffered input signal is amplified, then shaped into squarewaves by the Schmitt trigger. The last stage of the input amplifier translates the Schmitt trigger output into TTL (Transistor Transistor Logic) levels for application to the logic controlled main gate.

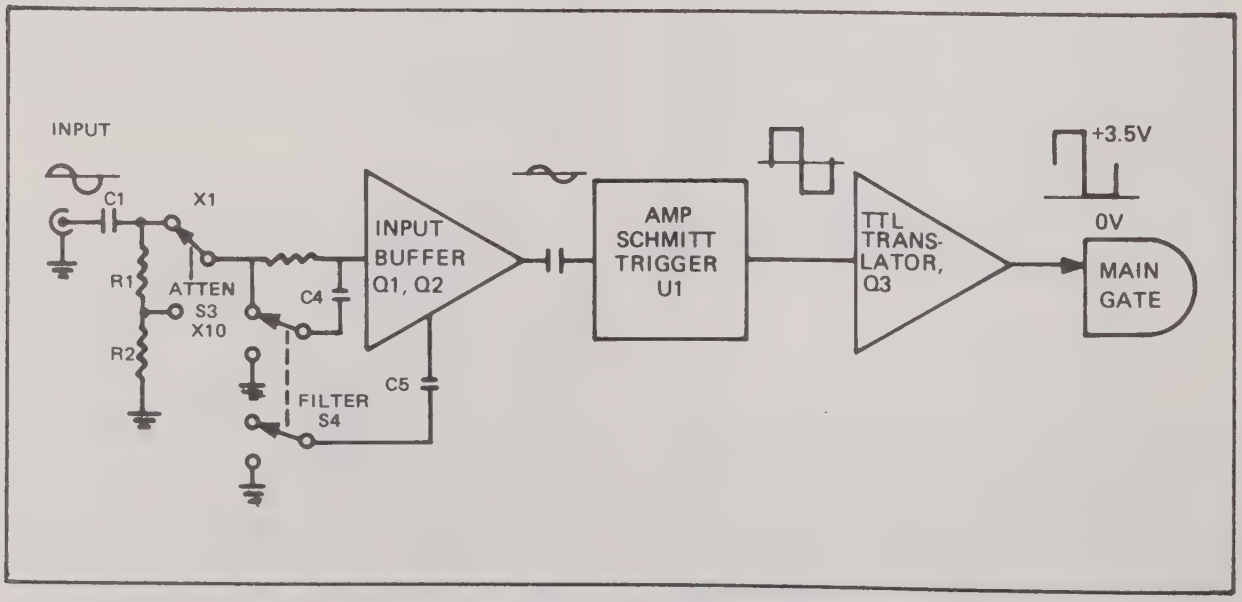

Figure 3-2. INPUT AMPLIFIER BLOCK DIAGRAM

3-9. Main Gate

3-10. The input signal, in TTL form, is applied to one input of the main gate, as shown in Figure 3-2. Because this gate input signal is alternating between a logic 1 and and logic 0 at the rate of the counter input signal, anytime the other input of the main gate is held at a logic 1 the output will change state at the same rate. The logic 1 that enables the main gate is supplied either continuously, when the totalize function is selected, or for precisely controlled time periods when a gate time or the RPM function is selected.

3-11. Clock (10 MHz)

3-12. The clock supplies the stable frequency used to time the events during measurement of the frequency of an input signal. Figure 3-3 shows the basic configuration of the clock and how the external clock input may be substisuted for the internally generated clock signal. The clock signal is translated into TTL compatible levels before being applied to the clock divider.

3-13. Clock Divider

3-14. The 10 MHz clock output signal is applied to the input of the first of three series connected TTL high-speed decade counters. Each counter divides its input by ten, thus reducing the 10 MHz input signal to a 10 kHz output, in the 1 ms – 1s gate times the 10 kHz signal is directly applied to the program logic. When the RPM button is selected the 10 kHz signal is divided by six, in a fourth high-speed counter, to produce a 1.666 kHz signal that is applied to the program logic.

3-15. Program Logic

3-16. The program logic (Figure 3-4) receives the clock divider output signal and divides it, in four series connected decade counters, to produce the 1 ms - 1s gate time control signals. The 1 ms gate time will be used in the following discussion. Because the program logic sequence of events is repetitive, the condition stated as a starting point for the program logic discussion will be seen again at the end of the discussion.

3-17. At the start of a measurement cycle, the main gate is closed and the reset signal applied to decade counters U9-U12 sets them to the count of nine. The next negative transition of the clock divider 10 kHz signal causes each decade counter to go to the count of ten, which drops the output of each counter from logic 1 to logic 0. The negative transition output at U9 is applied through the closed contacts of the 1 ms switch, to the first clock input of U13. The flip-flop toggles, causing the Q output to go to logic 1. The positive output enables the main gate and applies a bcd eight count to the BCD to decimal decoder. The eight count input to U8 prevents the two, four and five decimal outputs from updating and resetting the display or providing a reset command to U13, while the main gate is enabled.

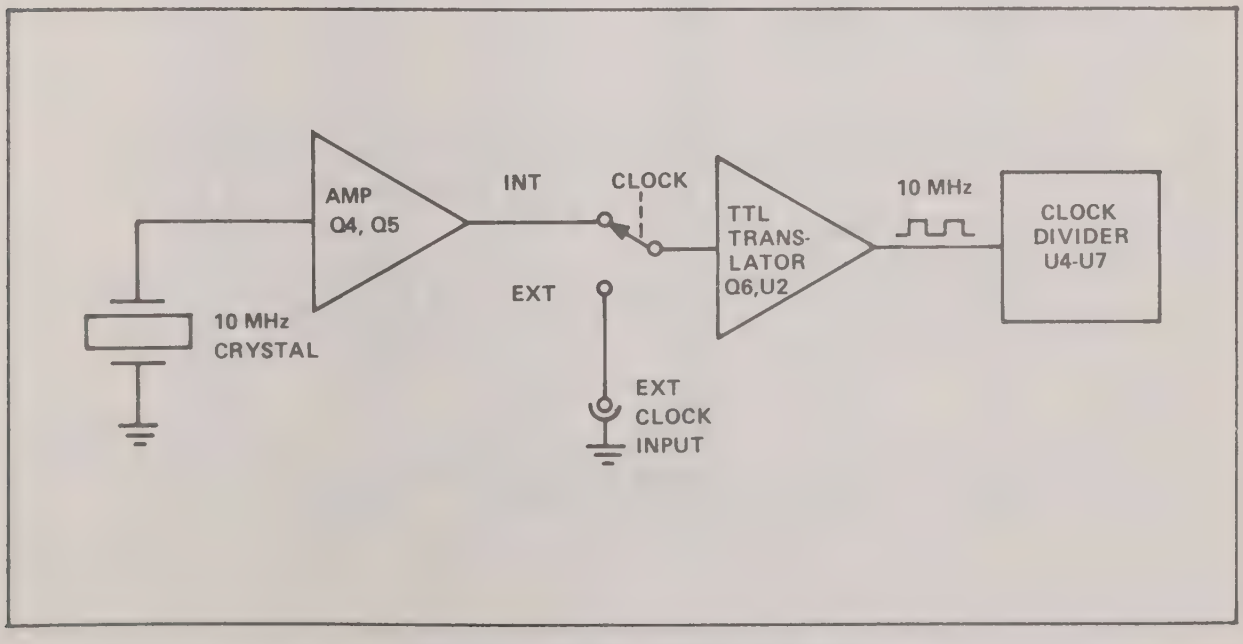

Figure 3-3. CLOCK (10 MHz) DIAGRAM

3-18. As decade counter (U9) counts the next ten cycles of the clock divider signal, the output of U9 will go to logic 1 on the count of eight, then back to logic 0 on the count of ten. The negative transition applied to the clock input of U13 again toggles the flip-flop causing the Q output to go from logic 1 to logic 0. This logic 0 closes the main gate and removes the BCD eight count from U8. The negative transition at the Q output U13 is applied to the second clock input U13. The flip-flop toggles, causing the Q output to go to logic 1.

3-19. Decade counter U9, counting the clock divider signal, again starts to count from one through ten. The decimal count of two from U8, causes U3 to generate the M (memory update) command. At the count of four, U8 enables U3 and U2 to produce the R (display reset) command. The decimal five output of U8 is applied to the reset of U13 causing the Q output to drop to logic 0. The logic 0 flip-flop output will momentarily cause the output of U3 to go to a logic 1. A logic 1 output of U3 turns Q7 off. The RC time constant of R41 and C28 holds Q7 off for 150 to 200 ms. The off condition of Q7 generates the logic 0 auto reset command that is applied to U3. The output at U3 goes to logic 1 for 150 to 200 ms causing each decade counter to be held at the count of nine until the end of the RC time constant. The next negative transition of the clock divider signal will start a new measurement cycle.

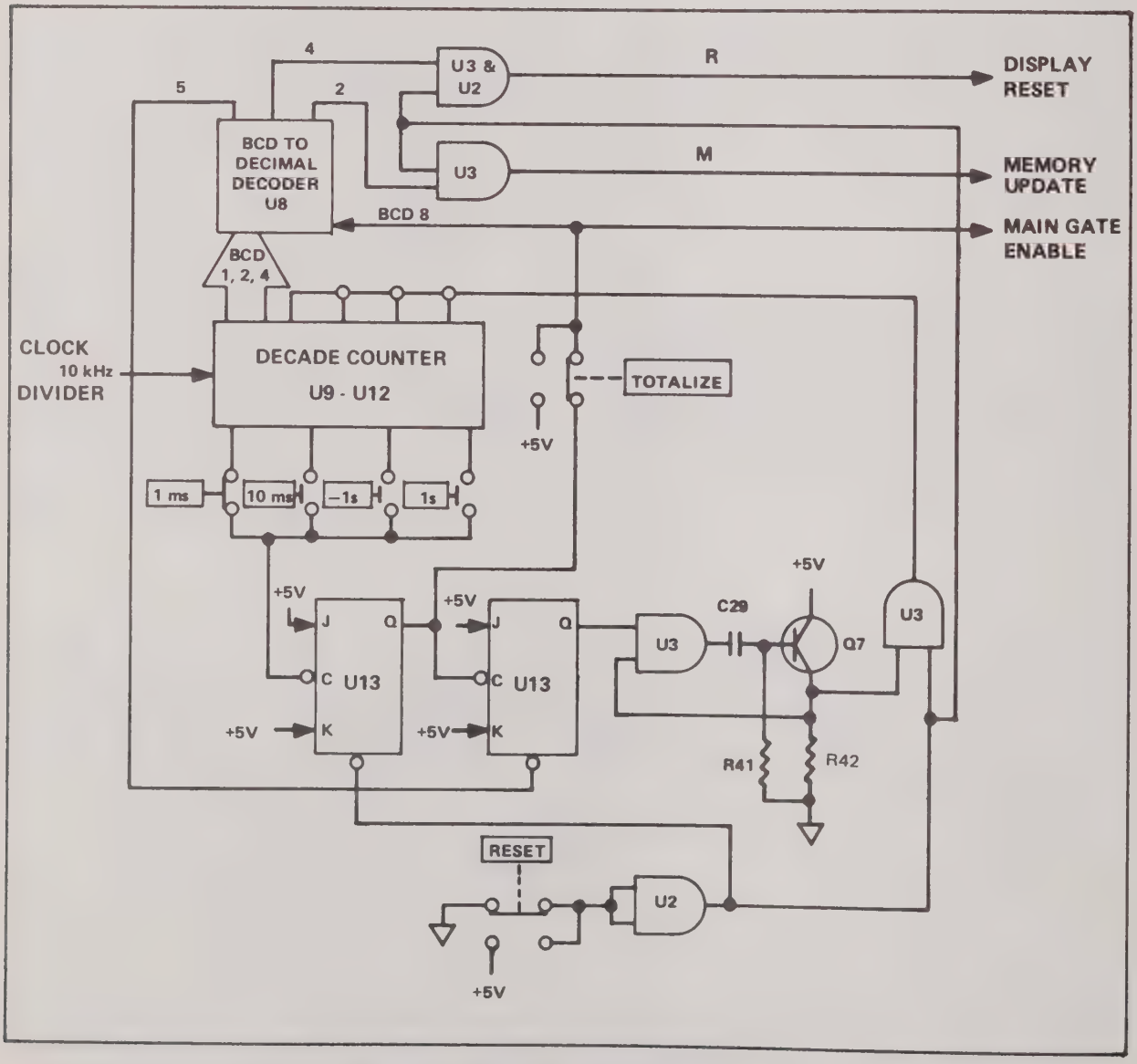

Figure 3-4. PROGRAM LOGIC DIAGRAM

3-20. A manual reset command is generated by U2 when the reset pushbutton is depressed. This action will set the decade counters U9-U12 to the count of nine to start a new measurement cycle at any time.

3-21. The 10 kHz clock divider signal controls the timing of the program logic. Figure 3-5 shows the relationship between the program logic events and the number of cycles of the 10 kHz clock divider signal that are applied to the decade counter U9.

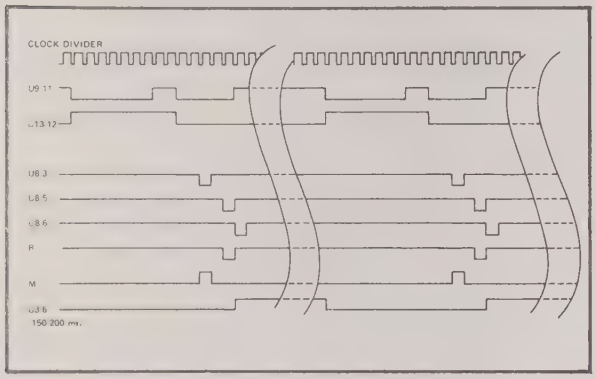

Figure 3-5. TIMING DIAGRAM

3-22. Count and Display

3-23. Figure 3-6 shows a block diagram of the count and display circuit. The diagram shows the digit display channels consisting of a BCD counter, a latch, a decoder driver, and a display tube.

3-24. When the main gate is opened by the program logic gate signal, the 1941A input signal is applied to the first of six series connected, BCD counters. As the main gate closes at the end of gate time, the decade counters will contain the equivalent of the frequency of the 1941A input signal. The display update (M signal from the program logic then opens the latch inputs and the information on the decade counters will update the display tube readout. The new BCD count in the latch is converted to a decimal decade equivalent by the decoder driver. The decoder driver output of each display channel will light the appropriate digit in each display tube.

3-25. If the input frequency count exceeds the display capacity, the output of the last decade counter is applied to U33-1. When the display update (M) signal is applied to U34-2 the overflow indicator will light.

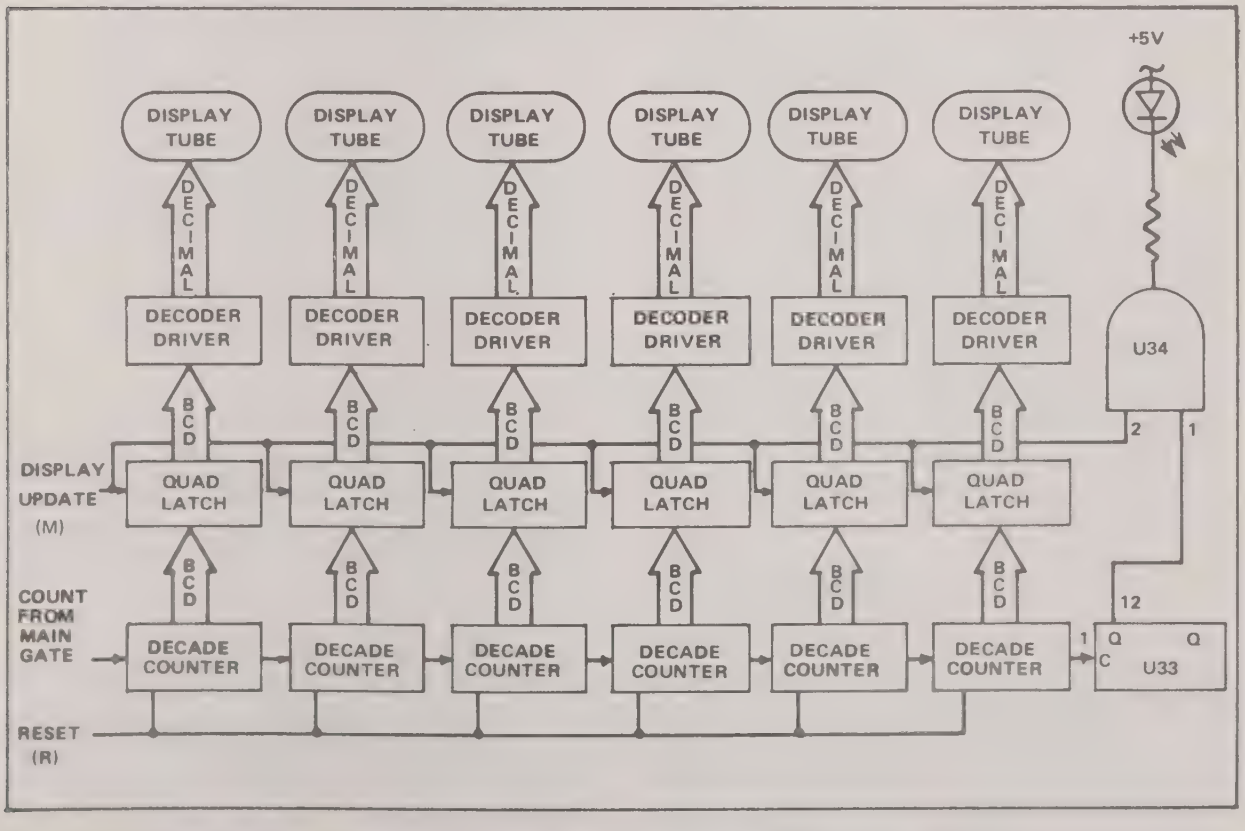

Figure 3-6. COUNT AND DISPLAY BLOCK DIAGRAM

Section 4
Maintenance

4-1. INTRODUCTION

4-2. This section contains service and maintenance information for the Model 1941A Digital Counter. The performance test and calibration procedures are designed to maintain instrument operation within the specifications of Section 1.

4-3. Service Information

4-4. Each instrument manufactured by the John Fluke Mfg. Co., Inc.; or John Fluke Mfg. Co. Ltd., is warranted for a period of one year from the date of delivery to the original purchaser. The warranty is located at the front of the manual.

4-5. Factory authorized calibration and service for each Fluke product is available at various world-wide locations. A list of authorized service centers is located at the front of the manual. Shipping information is given in Section 2. If requested, an estimate will be provided to the customer before any repair work is begun on instruments that are beyond the warranty period.

4-6. GENERAL MAINTENANCE

4-7. Cleaning

4-8. The Model 1941A should be cleaned periodically to remove accumulations of dust that may reduce proper heat dissipation by the components. The exterior should be cleaned using a cloth moistened with ordinary soap and water. Care should be taken when cleaning the interior of the unit, and should be done with clean dry air (about 20 psi). If the printed circuit boards require more than low pressure air to clean them, spray them first with Freon T.F. Degreaser (Miller Stephenson Co., Inc.) and then use low pressure air to remove the dirt.

4-9. Fuse Replacement

4-10. The input line power to the instrument is overload protected by a fuse installed on the rear panel. A decal giving the type and rating of the fuse is also located on the rear panel. If it becomes necessary to replace the fuse, insure the replacement fuse for 115 or 230V is the same value as specified on the rear panel decal.

4-11. MAINTENANCE ACCESS

4-12. Removable access covers are provided to make it easier to clean, troubleshoot and calibrate the 1941A. The following procedure should be used to gain access to the interior sections of the counter.

CAUTION!

To prevent accidental shorting of components or line power, remove the AC line power input prior to disassembly.

4-13. Component Access

a. Remove the top dust cover. Four Phillips head screws (two on each side) hold the cover in place.

b. Remove the bottom access cover.

4-14. Display Board Access

4-15. The display board can be lifted to provide access to the lower side, and to the components on the main PCB located under it. Lifting the display board for troubleshooting does not interfere with normal counter operation. The board can be lifted as follows:

a. Gently remove the Overflow LED from the mounting hole in the front panel.

b. Remove the four screws that secure the display board to the main PCB.

CAUTION!

When lifting the display board for troubleshooting, make sure the components and land patterns are not being shorted by the board supports before energizing the unit.

4-16. TEST EQUIPMENT

4-17. The equipment recommended for calibration and maintenance of the 1941A is listed in Table 4-1. If the recommended equipment is not available, equipment with equivalent specifications can be used.

4-18. PERFORMANCE CHECKS

4-19. The following checks can be used to verify the electrical specification of the Model 1941A. Each check includes an introduction which states the objectives. Refer to Table 4-1 for the recommended test equipment.

4-20. Should a problem with the operation of the counter be discovered, first determine if calibration is the cause. If the problem can not be corrected by recalibration, troubleshoot the instrument and repair as necessary.

Table 4-1. RECOMMENDED TEST EQUIPMENT

EQUIPMENT TYPE	RECOMMENDED EQUIPMENT	FUNCTION
Multimeter	Fluke Model 8000	Calibration and Troubleshooting
Oscilloscope	Tektronix 465	Troubleshooting
Frequency Standard	10 MHz (1 MHz or 5 MHz may be used)	Calibration, Performance Testing, and troubleshooting
Signal Generator	Wavetek 130 & Tektronix 191	Performance checks, calibration and troubleshooting
Autotransformer	General Radio Variac (W5MT3A)	Performance checks, calibration and troubleshooting

4-21. Preliminary Operation

4-22. When a problem is suspected, the possibility of shorted components causing excess current drain and thus further damage should be guarded against. The following procedure will determine if the counter is drawing an excessive amount of current:

a. Connect an autotransformer to a 115V ac line power source and set the output to zero volts.

b. Place the 1941A power selection switch in the 115V position.

c. Connect the counter input power cord to the autotransformer.

d. Depress the POWER push button.

e. Slowly increase the autotransformer output voltage to 115V. The current draw indicated on the autotransformer should not exceed 180 ma (20w).

4-23. Totalize, Reset, and Sensitivity Checks

4-24. This procedure will determine if the counter is able to display each digit of the individual display tubes, and check the operation of the reset circuitry.

a. Connect the counter to a 115V (230V) power source.

b. Set the front panel controls:

POWER	–	depressed (on)
TOTALIZE	–	depressed (in)
ATTEN	–	released (out)
FILTER	–	released (out)

c. Connect the signal generator output to the counter input jack.

d. Set the generator output to 5 Hz, 40 mV.

e. Momentarily depress the RESET button, note that the display first resets to zero, then digitally counts at a 5 Hz rate.

f. Depress the ATTEN switch;the count should stop.

g. Increase the signal generator output to 500 mv and the count should continue.

h. Slowly increase the generator frequency output, and observe the display for proper counting sequence of all remaining digits.

i. As the displayed count reaches the full display of 999999 note that the next count illuminates the OVERFLOW indicator and the display counts from 000000.

j. Depress the RESET button again, the OVERFLOW indicator should go off and the display will return to zero.

4-25. Decimal Range Check

4-26. The range of each gate time is either expressed in MHz or kHz as indicated on the front panel. The ability of each range to properly display the input frequency can be verified using the following procedure.

NOTE!

When the signal generator frequency is set for steps c, e, and g, note the exact counter reading. As the gate time is decreased in each case, the value of the frequency, as displayed on the counter, should not change more than ±1 digit.

a. Connect the output of the signal generator to the counter input jack.

b. Select the 1S gate time on the counter.

c. Set the signal generator output to 400 kHz at 1.0 volt. The counter should indicate 400.000 kHz.

d. Change the gate time to 0.1S. The display should now indicate 0400.00 kHz.

e. Increase the signal generator output frequency to 4.0 MHz. The 1941A display should indicate 4000.00 kHz.

f. Change the gate time to 10 MS. The counter should display 04.0000 MHz.

g. Increase the signal generator output frequency to 40.0 MHz. The counter should display 40.0000 MHz.

h. Change the gate time to 1 MS. The display should be 040.000 MHz.

4-27. TROUBLESHOOTING

4-28. The following information is provided to assist in locating malfunctions in the Model 1941A. It is recommended that the theory of operation in Section 3 be completely read and understood before troubleshooting is attempted.

4-29. Initial Troubleshooting

4-30. Troubleshooting begins by first performing a thorough inspection for, physically damaged parts, shorted component leads, or other obvious problems. It should be verified that the trouble is actually in the instrument and not caused by faulty external equipment or connections. For this reason, the 1941A should be exercised as described in the "Performance Test" to determine the cause for the malfunction. Careful observation of the performance test results may indicate the particular problem area in the counter. If the 1941A will not meet the performance test standards, and the calibration of the unit is not at fault, the following information may be used to help isolate the cause of the malfunction.

4-31. Power Supply

4-32. Improper voltage outputs from any of the power supplies can cause the 1941A to exhibit various malfunction symptoms. For this reason it is recommended that a check of each power supply output voltage be made after the visual inspection.

4-33. When checking the voltage outputs of each power supply the common of the multimeter should be connected to counter ground. A convenient ground is the signal return on the input jack. Figure 4-1 shows the points in the counter where the power supply output voltage may be monitored. The output of each supply should be within the following limits

10V Supply	9.5V to 10.5V	When the input power is at 115Vac (230V)
170V Supply	170V to 200V	
5V Supply	4.75V to 5.25V	

4-34. If one or more of the power supply voltages are found to be out of the prescribed range, an evaluation of the results of the voltage checks may isolate the problem in the power supply secton.

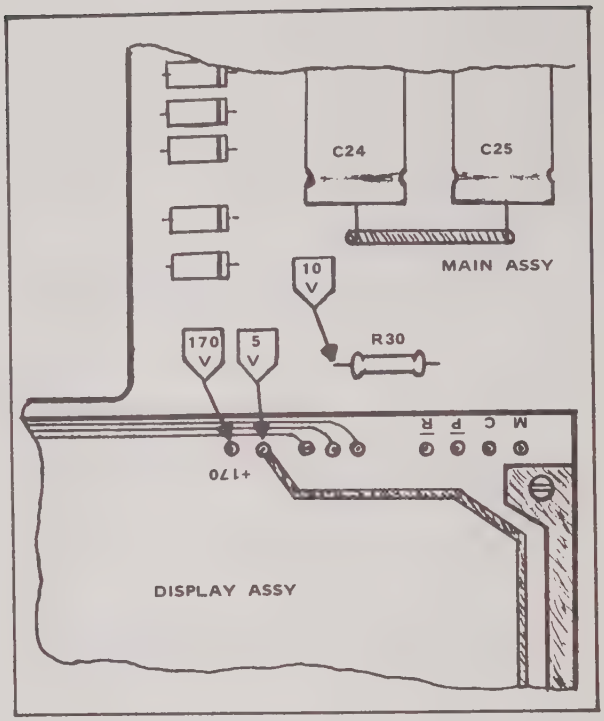

Figure 4-1. POWER SUPPLY TEST POINTS

a. When all three supplies are effected, check the position of the input power select-switch, the fuse (F1), capacitors C20 and C21, and the primary of transformer T1.

b. If only the 10V and 170V supply voltages are effected check CR3, CR4, C22 and the secondary of T1.

c. If the 5V supply is the only supply voltage that is improper the probable cause is U14 or capacitors C24-C27.

4-35. 10 MHz Clock

4-36. If the 1941A does not correctly determine the frequency of an input signal, the problem could be caused by the 10 MHz clock. It is possible to isolate the problem to the clock by checking other function of the counter.

4-37. The first thing to do is to see if the 1941A will count the cycles of a low frequency input signal in the TOTALIZE mode. This mode of operation does not use the 10 MHz clock oscillator.

a. Connect the signal generator, adjusted for 10 Hz at 0.5 volts, to the INPUT jack of the counter.

b. Depress the TOTALIZE button on the 1941A.

4-38. The display will count the input signal at a 10 Hz rate if the problem is in clock or program logic sections. To isolate the trouble to the 10 MHz clock itself an external 10 MHz clock must be substituted for the one in the counter.

a. On the rear panel, set the CLOCK INT EXT switch to EXT and connect the 10 MHz frequency standard to the CLOCK INPUT 10 MHz jack.

b. Connect the output of the signal generator to the 1941A INPUT jack. Set the generator output for about 650 kHz at 0.5 volts.

c. Depress the 1s-kHz pushbutton on the 1941A front panel. The counter should accurately display the value of the 650 kHz input.

4-39. If the 1941A accurately displays the input frequency using an external 10 MHz clock signal. The malfunction must be in the internal clock oscillator. Using an oscilloscope, the internal oscillators 10 MHz sinewave output can be checked at the emitter of Q5, then at the gate of Q4. The 10 MHz sinewave output of Q5 should be greater than 500 mV rms.

4-40. Program Logic and Clock Divider

4-41. The program logic section of the counter controls the timing of the signals that open and close the main gate, update the display, and reset the display. These control signals are used to automatically control the display when the RPM or one of the four gate time pushbuttons is selected. In the TOTALIZE mode the signals that open the main gate and update the display are furnished through contacts of the TOTALIZE pushbutton. For this reason most malfunctions in the program logic will not effect the TOTALIZE mode of operation.

4-42. When the results of the 10 MHz clock check (4-35) show that the 1941A will properly count the number of cycles of an input signal in the TOTALIZE mode, but will not properly display the frequency of an input signal using either an internal OR external clock signal, the malfunction is probably in the program logic or clock divider circuits. The following information can be used to isolate a malfunction within the clock divider or program logic.

a. Connect the scope input ground to the signal ground at the counter input jack.

b. Connect the scope input to pin 11 of U6.

NOTE!

It may be necessary to lift the display board in order to make the required connections in this procedure.

c. Set the scope controls to 1V/cm (X1 probe) and 20μs/cm. The scope should present a 3.5V square wave pulse 1 cm wide, every 5cm. This would indicate that the clock divider is operating properly.

4-43. The clock divider output signal is divided by four series connected decade dividers (U9-U12), in the program logic. The proper operation of all four dividers can be checked using the following procedure.

a. Connect the scope input ground to the signal ground on the counter input jack.

b. Connect the scope input to pin 11 of U12.

c. Depress 1 sec gate pushputton.

d. With the scope controls set at .2 sec/cm and 2V/cm (X1 probe) the scope should present a 1.5 cm square wave pulse approximately 4 volts high, every 5 cm.

4-44. The display reset (R) and display update (M) signal outputs from the program logic can be checked for proper operation. The automatic generation (in the RPM or gate time modes) of these two signals is an indication that the program logic is functioning properly. To check these two signals proceed as follows:

a. Select the 0.1s gate time on the 1941A front panel.

b. Connect the scope input ground to the signal ground on the counter input jack.

NOTE!

The display reset and display update signals can be monitored at the right rear corner of the display board. The display reset is marked $\overline{R}$ and the display update is marked M.

c. Connect the scope input to the $\overline{R}$ signal pad.

d. With the scope controls set at 0.1 sec/cm and 2 volt/cm (X1 probe) the scope should present a signal level of approximately 3.5 volts with spike transitions to about zero volts each centimeter.

e. Move the scope input probe from the $\overline{R}$ to the M signal pad. With the same scope settings, the scope should present a signal level of approximately zero volts with positive spikes to about 3.5 volts every centimeter.

4-45. The program logic should generate one reset pulse (3.5V to 0V spike) and one update pulse (0V to 3.5V spike) for each gate time period. The proper operation of the program logic in other gate times can be checked by observing the change in the pulse rate of each signal when the gate time is changed.

4-46. Input Amplifier

4-47. A malfunction in the input amp would cause both the totalize and gate time modes of operation to present an improper display. The input amp can be checked using the following procedure:

a. Connect the scope input ground to the signal ground on the counter input jack.

b. Connect the scope input to the collector of Q3.

c. Apply a 10 kHz 400 mV signal to the 1941A input jack.

d. With the scope controls set at 1V/cm and 50μs/cm (X1 probe) the presentation should be one complete cycle of a 3.5 volt square wave every centimeter.

4-48. Count and Display

4-49. The count and display circuit is supplied with an input signal from the main gate, a reset and update signal from the program logic, and +5 volt and +170V power from the power supply. These inputs are checked by the procedures outlined in the preceeding paragraphs.

4-50. Of the five input signals to the count and display, the input signal is the one that may check out correctly in the preceeding paragraphs but still affect all six display tube readouts. The +5V and +170V power supply inputs, and the reset and update signals are connected to the six display channels in parallel. A display malfunction caused by one of these four inputs should affect only the display channel where the malfunction occurred.

4-51. The bcd count input and output of each display channel BCD counter and quad latch can be checked for proper information to find which channel or which component is causing the problem. The following procedure can be used to check the bcd signals of each component:

a. Connect the signal generator, adjusted for a 10 Hz output, to the 1941 input jack.

b. Depress the TOTALIZE button on the front panel.

c. Connect the scope input ground to the signal ground on the counter input jack.

d. The scope input should be connected to each of the bcd output pins of the first BCD counter (A output pin 5, B pin 9, C pin 2, and D pin 12).

NOTE!

Each output pin of the BCD counter should go from a 0 volt to approximately +3.5 volts as it converts the count input square wave to bcd output. If the relationship of the bcd count to the displayed digit in the first BCD counter channel is too fast to be seen the signal generator input can be disconnected and the bcd equivalent of the digit displayed can be checked.

e. Connect the scope input to the bcd output pins of each of the other five BCD counters, and check the relationship of the bcd information to the displayed digit.

4-52. The quad latch BCD output can be checked in a similar manner to that of the BCD counter. The bcd outputs of each quad latch are: output A on pin 16, B pin 10, C pin 9, and D pin 15.

4-53. CALIBRATION

4-54. The 1941A should be calibrated every six months, or whenever repairs have been made. The calibration adjustment locations are shown in Figure 4-2.

4-55. Clock Oscillator Adjustment

4-56. The clock oscillator 10 MHz output frequency can be accurately set using either method listed below. The first method described should be used when an accurate frequency standard is available, and the alternate method may be used when a suitable frequency standard is not available.

4-57. OSCILLATOR ADJUSTMENT USING A FREQUENCY STANDARD

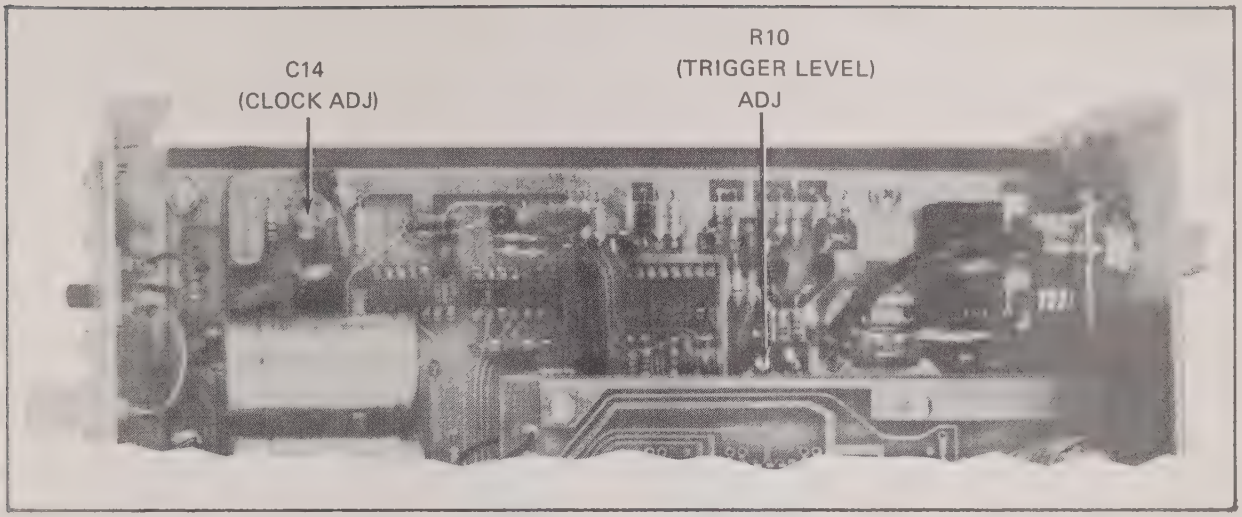

Figure 4-2. ADJUSTMENT LOCATIONS

4-58. Before performing the following procedure, insure that the frequency standard is up to specified operating temperature to insure proper accuracy of the timebase oscillator adjustment.

a. Connect the output of the frequency standard to the input jack of the counter.

b. Adjust the frequency standard for 10 MHz at 100 mV.

c. Depress the 1s pushbutton.

d. Adjust C14 (Clock Adjustment) for a counter display of 000.000 ±1 digit.

4-59. OSCILLATOR ADJUSTMENT USING A SHORT-WAVE RECEIVER.

4-60. This procedure requires the counter to be in close proximity to the receiver antenna lead-in cable.

a. Remove the top and bottom covers of the 1941A counter.

b. Tune the SW receiver to the 10 MHz WWV broadcast.

c. Bring the 1941A near enough to the SW receiver antenna lead so that a zero beat note can be heard on the receiver speaker. If insufficient radiation is picked up from the counter, turn the timebase oscillator towards the antenna and move it in close.

d. Tune the 1941A timebase oscillator adjust for a "zero beat" on the receiver.

e. Look at the receiver signal level meter, and adjust the timebase for an exact null. This will put the timebase oscillator output frequency within 1 Hz of the 10 MHz requirement.

4-61. Trigger Level Adjustment

4-62. The 1941A trigger level must be adjusted for maximum sensitivity to insure that the counter will count low level (40 mV) input signals. The trigger level adjustment procedure is accomplished as follows:

a. Adjust the signal generator output for 50 MHz at 40 mV.

b. Connect the generator to the 1941A input jack.

c. Depress the 1 ms pushbutton.

d. Rotate the trigger level adjustment (R10) through the portion of the adjustment movement that provides a stable display of the 50 MHz input.

e. Position R10 to the center of the adjustment range that produced a stable display.

Section 5
Lists of Replaceable Parts

TABLE OF CONTENTS

ASSEMBLY NOMENCLATURE	FLUKE STOCK NO.	PAGE
Final Assembly	1941A	5-3
Main Assembly	367557	5-5
Display Assembly	367581	5-9

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alphanumerically by assembly. Electrical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

a. Reference Designation or Item Number.

b. Description of each part.

c. Fluke Stock Number.

d. Federal Supply Code for Manufacturers. (See Appendix A for Code-to-Name list.)

e. Manufacturer's Part Number or Type.

f. Total Quantity per assembly or component.

g. Recommended Quantity: This entry indicates the recommending number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one in each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

h. Use Code is provided to identify certain parts that have been added, deleted or modified during production of the instrument. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity, paragraph 5-7.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information:

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation or Item Number.

e. Printed Circuit Board Part Number.

f. Instrument Model and Serial number.

5-7. USE CODE EFFECTIVITY LIST

USE CODE	SERIAL NUMBER EFFECTIVITY

FINAL ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY **Figure 5-1**	1941A					
	Main Assembly Figure 5-2	367557	89536	367557	1		
	Display Assembly Figure 5-3	367581	89536	367581	1		
	Chassis Assembly	367599	89536	367599	1		
CR10	Diode, light emitting	369777	28480	5082-4480	1		
F1	Fuse, fast acting, 1 amp	369819	71400	AGC	1		
FX1	Fuseholder	100107	71400	HKJ	1		
T1	Transformer, 115/230V	370478	89536	370478	1		
	Cable, coaxial	245514	13511	21-597	AR		
	Cover, access	371609	89536	371609	1		
	Cover, bcd	367508	89536	367508	2		
	Cover, top	365254	89536	365254	1		
	Pushbutton, grey	355263	71590	J52304	9		
	Pushbutton, green	268862	71590	J61993	1		
	Line cord	343723	70903	TYPE 17250	1		

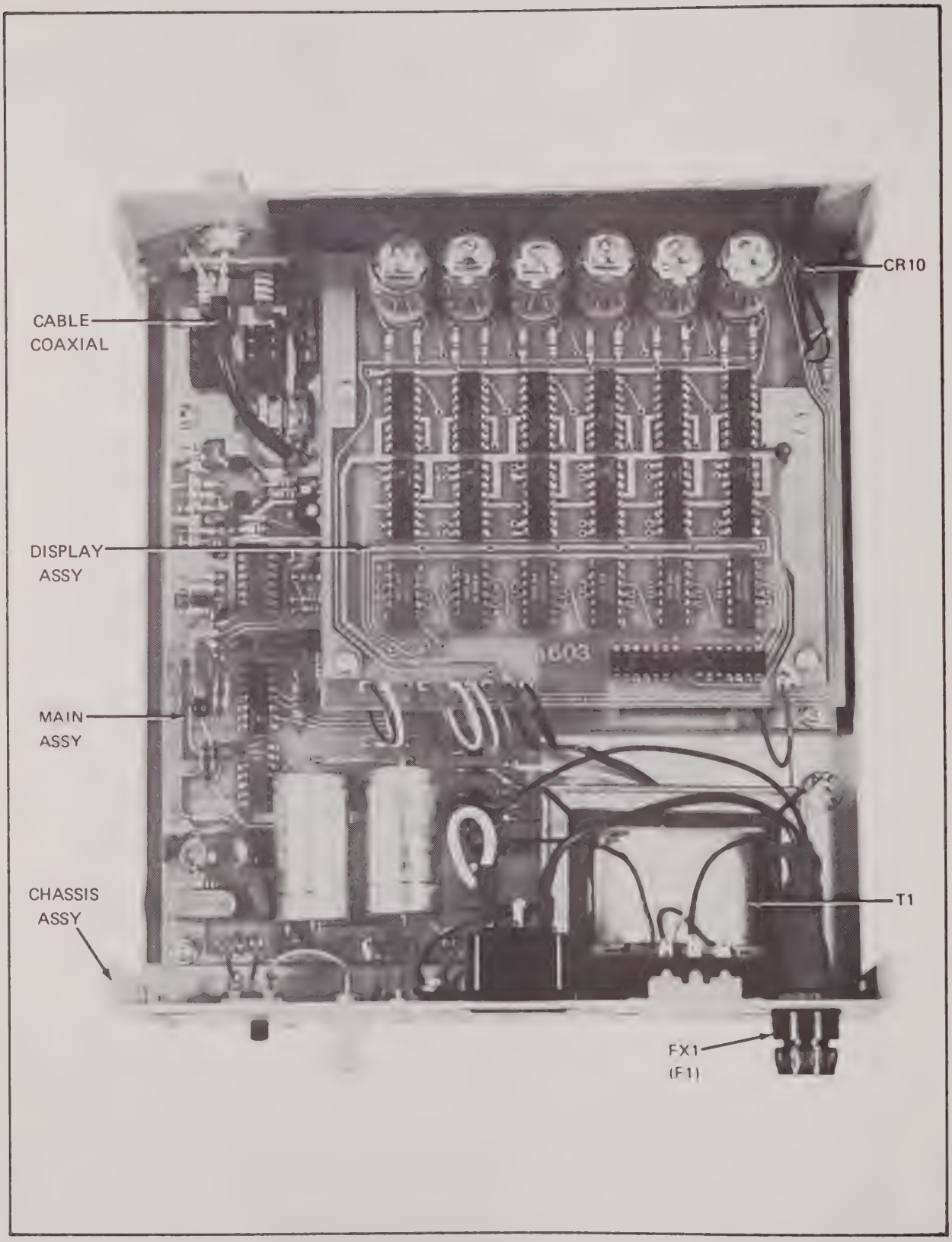

Figure 5-1. FINAL ASSEMBLY

MAIN ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	MAIN ASSY Figure 5-2						
C1	Cap, Mylar, .022μf 630V	369165	25403	C280MAF22K	1		
C2	Cap, disc. 4.7 pf ±0.25 pf, 100V	362772	32879	8101A100CUG 479G	1		
C3, C17	Cap, elect, 47pf, 1000V	369132	36289	X030B102H4 70J	2		
C4, C12, C13, C16	Cap, elect, 22 pf ±20%, 250V	369157	32879	831-000=C0G 0220	4		
C5, C31	Cap, disc, 300 pf, ±10%, 50V	105734	71590	BB60301KW 7W	2		
C6, C7, C8, C11, C15, C26, C27, C29	Cap, tant, 10 μf ±20%, 15V	193623	56289	196D106X100 15JA1	8		
C9, C10	Cap, disc, 0.1 μf, 20V	369199	14655	HCC25104P	2		
C14	Cap, var, 22 pf	369207	89536		1		
C18, C19	Cap, disc., .01μf, +80/−10%, 20V	335786	32897	5835-000Y5U 1032	2		
C20, C21	Cap, disc., .005 μf, ±20%, 1200V	188003	71590	2DDH6R502M	2		
C22	Cap, elect, 4μf 400V	369215	89536		1		
C23	Cap, elect, 220μf, ±40%, 25V	369181	34553	ET221X025A00	1		
C24, C25	Cap, elect, 4700μf, +100%/−10%, 10V	340893	99392	601C1DBA553	2		
C28	Cap, disc., .001μf, +100/−20%	369140	32897	810/A50-651-1022	1		
CR1, CR2	Diode 1N914	364224	89536		2		
CR3, CR4, CR6, CR7, CR8, CR9	Diode Si, Rectifier	368738	01295	1N4004	6		

MAIN ASSY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R24	Res, comp, 22 ±5%, ¼W	147884	01121	CB2205	1		
R31,	Res, comp, 47k ±5%, ¼W	148163	01121	CB4735	1		
R32	Res, comp, 68k ±5%, ¼W	148171	01121	CB6835	1		
R34, R38	Res, comp, 820 ±5%, ¼W	148015	01121	CB8215	2		
R35	Res, comp, 39 ±5%, ¼W	193391	01121	CB3905	1		
R36, R37	Res, comp, 6.8k ±10%, 2W	110064	01121	HB6825	2		
R39, R40	Res, comp, 1.2k ±5%, ¼W	190371	01121	CB1225	2		
R41	Res, comp, 22k ±5%, ¼W	148130	01121	CB2235	1		
U1	IC	369702	04713	MC10116L	1		
U2	IC, TTL, Quad 2-Input Positive NAND Gate	293068	01295	SN74400N	1		
U3	IC, TTL, Quad 2-Input NAND Gate	292953	01295	SN7400N	1		
U4, U5, U6, U9, U10, U11, U12	IC, TTL, MSI Decade Counters	293159	01295	SN7490N	7		
U7	IC, TTL, MSI Divide by Twelve counter	293225	01295	SN7492N	1		
U8	IC, TTL, BCD to Decimal Decoder	293142	01295	SN7442N	1		
U13	IC, Dual J-K Master-Slave Flip-Flop	368571	89536	SN7473	1		
U14	IC,	355107	04713	MC 7805CP	1		
Y1	Crystal 10 MHz	369744	89536	369744	1		

MAIN ASSY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR5	Diode zener	180406	07910	1N758	1		
L1	Inductor	147835	72259	WEE220	1		
Q1	Tstr, FET, N-Channel	288324	07910	U2412E	1		
Q2, Q3	Tstr, 5X3819	369629	89536	369629	2		
Q4	Tstr, 5X3819	369637	02395	2N5951	1		
Q5, Q6	Tstr,		07263	2N4274	2		
Q7	Tstr, S X4061	369652	89536	369652	1		
R1, R27	Res, comp, 1M ±5%, ¼W	182204	01121	CB1055	2		
R2, R11, R43	Res, comp, 100k ±5%, ¼W	148189	01121	CB1045	3		
R3, R15, R26	Res, comp, 180 ±5%, ¼W	147942	01121	CB1815	3		
R4	Res, comp, 120k ±5%, ½W	179598	01121	CB1245	1		
R5, R20, R21	Res, comp, 1k ±5%, ¼W	148023	01121	CB1025	3		
R6	Res, comp, 10 ±5%, ¼W	147868	01121	CB1005	1		
R7	Res, comp, 470 ±5%, ¼W	147983	01121	CB4715	1		
R8, R17, R19, R30, R33, R42	Res, comp, 390 ±5%, ¼W	147975	01121	CB3915	6		
R9	Res, comp, 270 ±5%, ¼W	160804	01121	CB2715	1		
R10	Res, comp, 10 ±5%, ¼W	369553	89536	369553	1		
R12, R13, R14, R15, R16, R18, R22, R23, R28, R29	Res, comp, 2.2k ±5%, ¼W	148049	01121	CB2225	10		

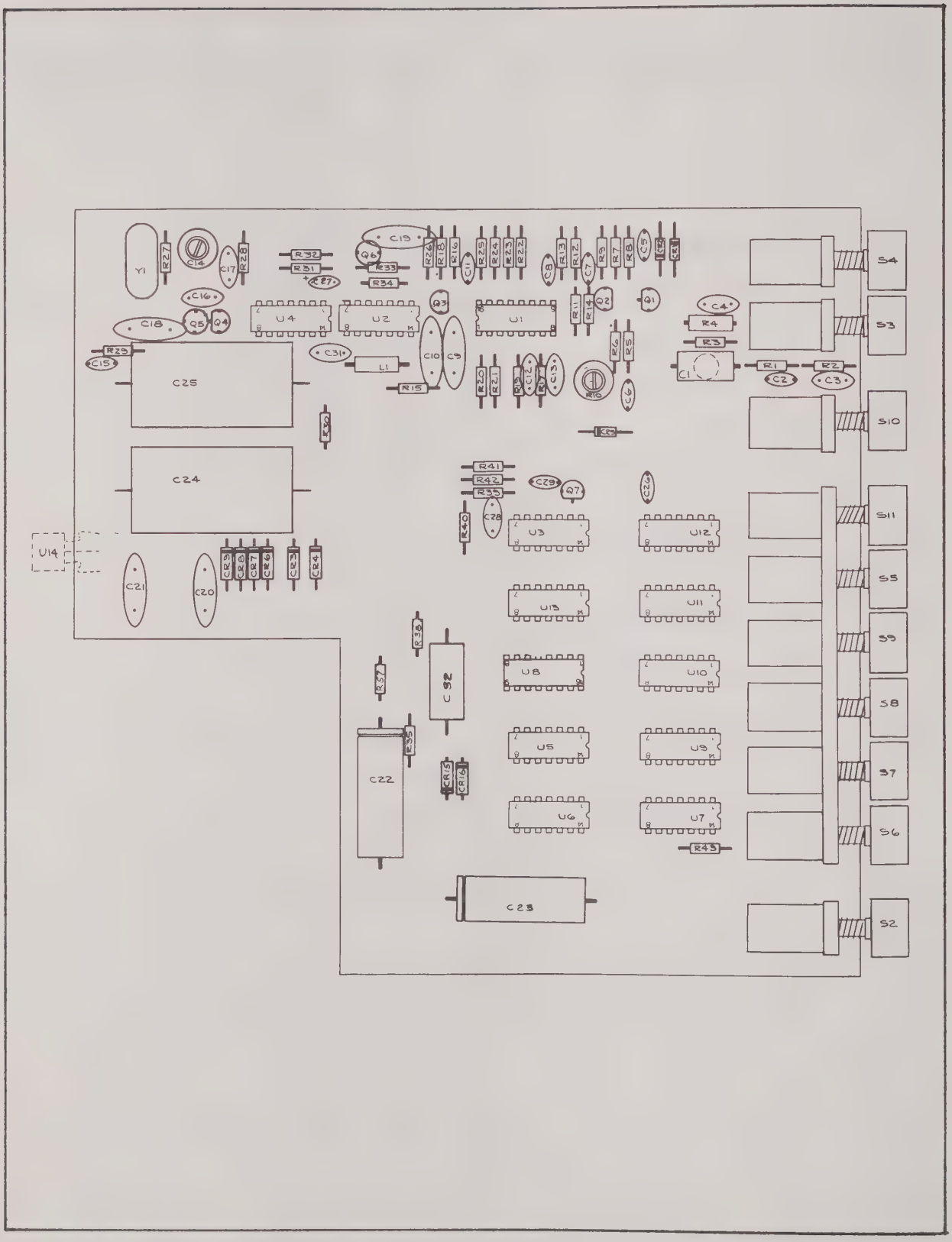

Figure 5-2. MAIN ASSEMBLY

DISPLAY ASSY.

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	DISPLAY ASSY Figure 5-3						
C30	Cap, tant 10μf ±20%, 16V	193623	56289	196D106X0015JA1	1		
R44, R46, R48, R50, R52, R54	Res, comp, 15k ±5%, ¼W	148114	01121	CB1535	6		
R45, R47, R49, R51, R53, R55	Res, comp 10M ±5%, ¼W	194944	01121	CB1065	6		
R56	Res, comp 82 ±5%, ¼W	149484	01121	CB8205	1		
U15, U18, U21, U24, U27, U30	IC, 50 MHz Decade Counter	320754	01295	SN7419 6N	6		
U16, U19, U22, U25, U28, U31	IC, TTL, Bistable i Latch	368522	89536	SN7475N	6		
U17, U20, U23, U26, U29, U32	IC, TTL, BCD to Decimal Decoder/Driver	369710	89536	SN74141N	6		
U33	IC, DUal J-K Master-Slave Flip-Flop	368571	89536	SN7473	1		
U34	IC, TTL Quad 2-Input NAND Gate	292953	01295	SN7400N	1		
V1, V2, V3, V4, V5, V6	Display tube	369801	89536	369801	6		

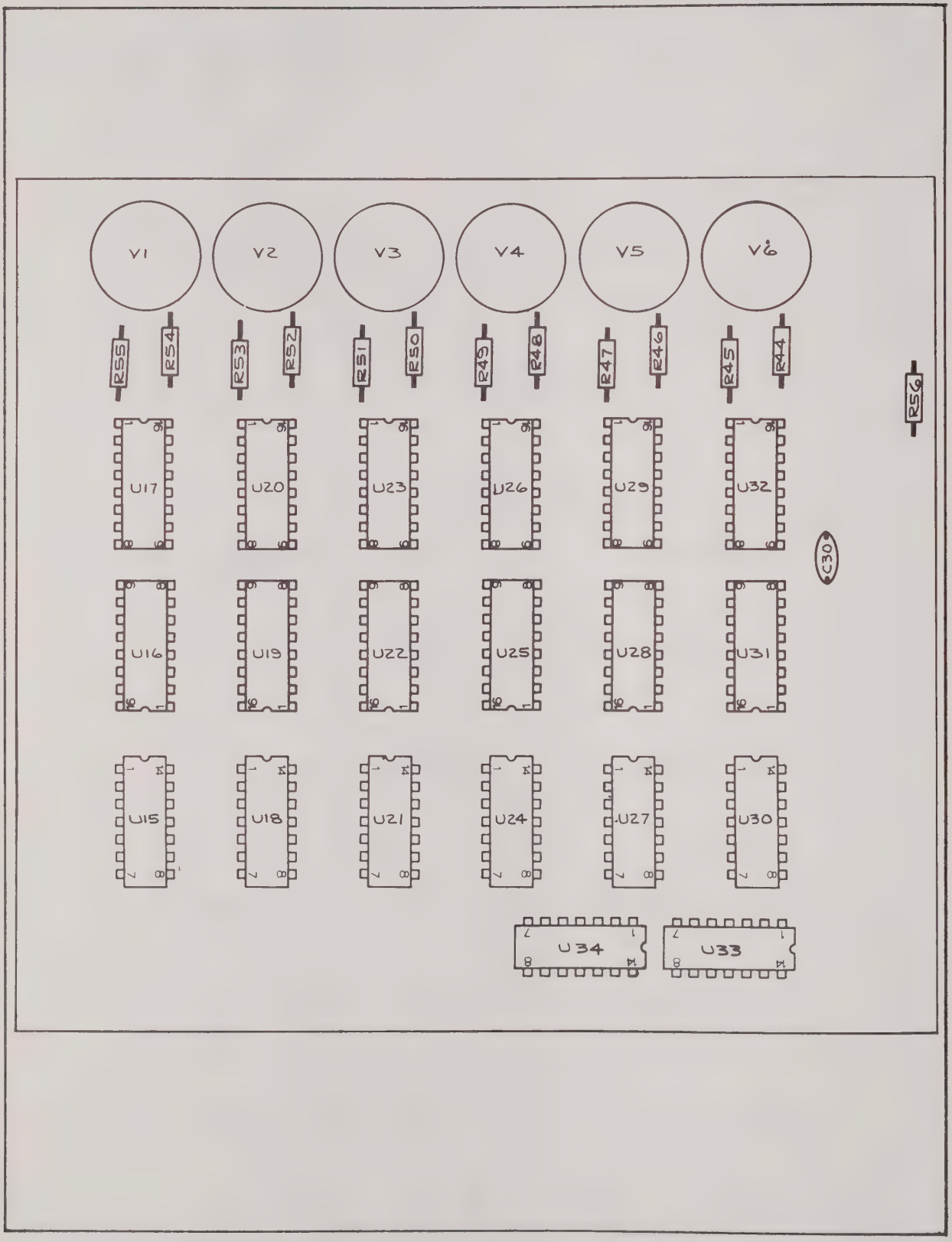

Figure 5-3. DISPLAY ASSEMBLY

Section 6

Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the accessories and options available for your instrument.

6-3. OPTION INFORMATION

6-4. Each of the options available for this instrument, if any, are described separately under headings containing the option number. The option descriptions contain applicable operating and maintenance instructions and field installation procedures for the field installation options. A complete list of replaceable parts for each option is contained at the end of that option description.

6-5. ACCESSORY INFORMATION

6-6. The accessory information, if applicable, will contain details concerning accessories that may be used with this particular instrument.

Option-02
BCD Output

6-1. INTRODUCTION

6-2. The BCD Output is installed as the –02 option. This option can be installed at the factory during manufacture or later in the field, as desired. The field installation kit for the BCD Output is identified as the 1941A-02K.

6-3. INSTALLATION

6-4. Use the following procedure when installing the BCD Output option-02 in the 1941A.

a. Disconnect the line cord from the unit.

b. Remove the top dust cover.

c. Remove the cover from the BCD output opening in the rear panel of the counter and retain the screws.

d. Pass the wire leads through the BCD output opening, from the rear, and fit the connector into the opening.

e. Secure the connector to the rear panel using the two screws removed in step c.

6-5. The internal connections must be made properly in order to obtain correct information from the BCD output connector. The following procedure must be used when installing the BCD output option. Refer to Figure 6-1 for the internal connection points. Table 6-1 lists the display assembly connection point for each BCD output connector pin. Steps c through f are a step-by-step example of the first four connections to be made in Table 6-1. Make the remaining indicated connection in the order given.

a. Solder the violet wire (BCD output connector pin 18) to the "M" signal pad on the main assembly.

b. Solder the green wire (BCD output connector pin 36) to the ground connection pad in the left rear corner of the main assembly.

c. Solder the brown wire, attached to pin 19 of the output connector, to the "A" pad of U31.

d. Solder the gray wire, attached to pin 20 of the output connector, to the "D" output pad of U31.

e. Solder the red wire, attached to pin 1 of the output connector, to the "B" output pad of U31.

f. Solder the yellow wire, attached to pin 2 of the output connector, to the "C" output pad of U31.

g. Make each remaining connection in the order given in Table 6-1.

h. Using a multimeter check continuity from the connector pin to the corresponding internal connection point.

i. Clamp the BCD output wires into a bundle approximately three inches from the output connector then again six inches from the connector.

j. Replace the top dust cover.

6-6. To check the performance of the −02 option, connect the BCD output to a remote display and complete the totalize and reset checks (paragraph 4-23). Note that the remote display is identical to the 1941A display.

Table 6-1. BCD OUTPUT OPTION INTERNAL CONNECTIONS

BCD OUTPUT CONNECTOR		CONNECTS TO	
PIN NO.	WIRE COLOR	DISPLAY ASSY. REF DESIG.	REF. DESIG. BCD OUTPUT PAD
19	BROWN	U31	A
20	GRAY	U31	D
1	RED	U31	B
2	YELLOW	U31	C
22	BROWN	U28	A
23	GRAY	U28	D
4	RED	U28	B
5	YELLOW	U28	C
25	BROWN	U25	A
26	GRAY	U25	D
7	RED	U25	B
8	YELLOW	U25	C
28	BROWN	U22	A
29	GRAY	U22	D
10	RED	U22	B
11	YELLOW	U22	C
31	BROWN	U19	A
32	GRAY	U19	D
13	RED	U19	B
14	YELLOW	U19	C
34	BROWN	U16	A
35	GRAY	U16	D
16	RED	U16	B
17	YELLOW	U16	C

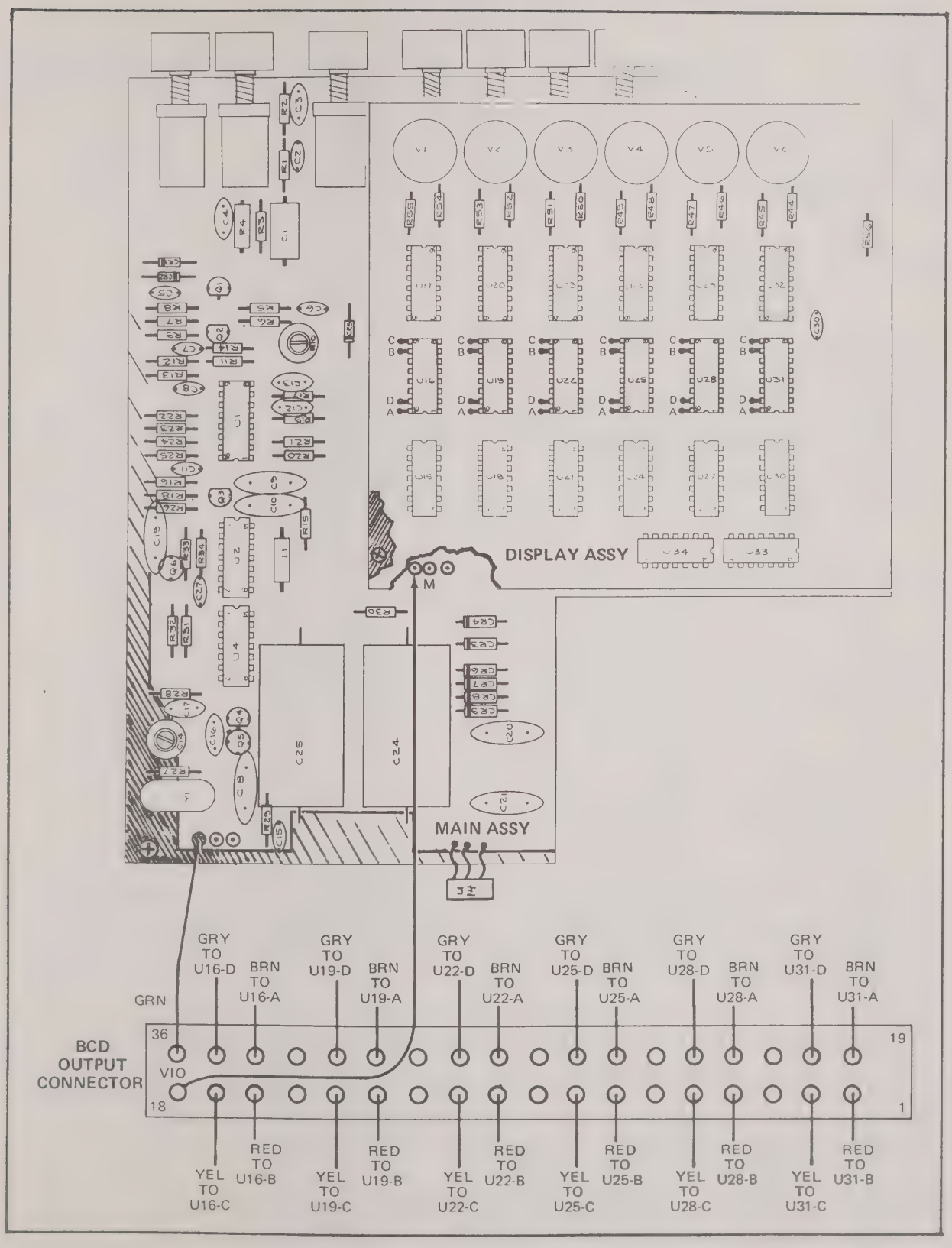

Figure 6-1. BCD OUTPUT CONNECTIONS

DIGITAL COUNTER - BCD OUTPUT OPTION

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	DIGITAL COUNTER - BCD OUTPUT OPTION	1941A-02					
	NOTE! *The basic Model 1941A can be modified in the field by installing the BCD Output Option (1941A-02). Order the kit by model number and option number; (1941A-02K). The kit includes the following components:*						
	BCD Output Connector Assembly	367607	89536	367607	1		
	BCD Output Adapter				1		
	Screw	149534	73734	18002	2		
	Clamp, cable	172080	06383	SST-1	3		

Option-05
BCD Preset

6-1. INTRODUCTION

6-2. The BCD preset (Option –05) provides a means for offsetting the counter display prior to the application of the input signal. The desired preset is applied through a connector located on the rear panel of the counter. An individual preset value is applied to each digit of the display through the single BCD preset connector.

6-3. PRESET PROCEDURE

6-4. A preset value is selected that will produce an overflow condition when the input signal has reached the desired frequency. The value of the preset is derived by subtracting the desired frequency from the overflow condition of the selected range.

6-5. Determining the Preset

6-6. The following examples will illustrate how the bcd preset is selected for the same input frequency on various ranges. In each case it must be remembered that the derived preset is for the indicated range only. When the counter range is changed a new preset value must be determined. An input frequency of 1.436578 MHz will be used in each example.

Example #1: If the counter range was set at 10 ms and the 1.436578 MHz applied as an input, the six digits of counter display would be 01.4365. In order to make the display indicate an overflow condition with a 1.436578 MHz input, the display must first be preset by some number. The formula used to determine the preset is:

Overflow	1	00.0000	10 ms range overflow display
Minus		01.4365	Input frequency
		98.5635	preset required.

Example #2: Changing the counter range to 0.1s requires a new preset. The counter display of the 1.436578 MHz input in the 0.1s range would be 1436.57 kHz. In order to make the display overflow, a preset value must be applied to the display. The preset is determined as follows:

Overflow	1	0000.00 kHz	0.1s range overflow display
Minus		1436.57 kHz	input frequency
		8563.43	preset required

Even though the input remained the same, a new preset is required for the new range.

Example #3: In this example the range will be 1s. With an input frequency of 1.436578 MHz the counter display would be in an overflow condition without a preset entered. The display would be:

Overflow	2	000.000 kHz	1s range overflow display
Minus	1	436.578 kHz	input frequency
		563.522	preset required

6-7. From these examples, it can be seen that a preset measurement of any frequency to 40 MHz can be made to a resolution of 1 Hz. The preset number will be a six-digit number that, when added to the six displayed digits of an input frequency, will cause the counter display to be:

Overflow 000000

6-8. Entering the Preset

6-9. The preset is applied to the counter through the bcd preset connector located on the rear panel of the 1941A. A mating connector, wired with the determined preset value, is plugged into the counter rear panel connector in order to preset the display. The following paragraphs set forth the procedure for wiring the mating connector for the desired preset value.

6-10. The preset value determined in example number one of paragraph 6-6 will be used to illustrate how the mating connector is wired to give the desired preset. Each of the six digits of the preset number must be applied to the proper display tube via the mating connector. The six display tubes numbered V1 (least significant digit) to V6 (most significant digit) will each be preset with the corresponding significant digit of the preset number.

6-11. Each display tube V1-V6 has four mating connector pins assigned for the bcd code (1, 2, 4, and 8) preset. Table 6-1 shows the mating connector pin numbers and associated bcd code for each display tube.

6-12. The preset number for each display tube is produced by grounding the pins of the bcd code NOT used to produce the number, to pin 36. The connections necessary to create the preset of paragraph 6-6 example one are shown in Figure 6-1.

6-13. To make the number of ground connections necessary for a preset entry, a short length of bus wire can be connected from pin 36 to pin 3 (spare) to form a loop. Bus wire soldered to the pins, corresponding to the BCD code to be grounded, can then be attached to pin 36 via the wire loop.

Table 6-1. PRESET CONNECTOR PIN IDENTIFICATION

TUBE NO.	V1	V2	V3	V4	V5	V6
BCD Code	1 2 4 8	1 2 4 8	1 2 4 8	1 2 4 8	1 2 4 8	1 2 4 8
Pin No.	34 16 17 35	31 13 14 32	28 10 11 29	25 7 8 26	22 4 5 23	19 1 2 20

PRESET NUMBER	9	8	5	6	3	5
TUBE NUMBER	V6	V5	V4	V3	V2	V1
PINS TO BE GROUNDED	1 and 2	22, 4 and 5	7 and 26	28 and 29	14 and 32	16 and 35

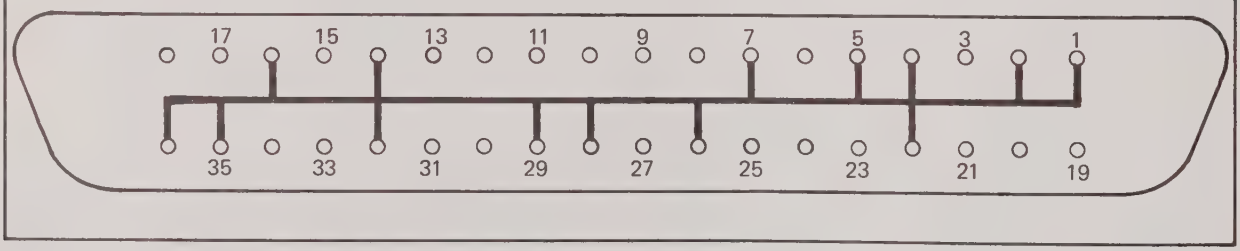

Figure 6-1. MATING CONNECTOR PRESET CONNECTION EXAMPLE.

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	DIGITAL COUNTER - BCD OFFSET OPTION	1941A-05					
	NOTE! *The basic Model 1941A can be modified at the factory by installing the BCD Offset Option (1941A-05). The option includes the following components.*						
	BCD Offset Assembly	365221	89536	365221	1		
	BCD Mating Connector				1		
	Clamp, Cable	172080	06383	SST-1	3		

Appendix A

Federal Supply Code for Manufacturers

A-1. CODE TO NAME

A-2. The following five digit code numbers are listed in numerical sequence along with the manufacturer's name and address to which the code has been assigned. The Federal Supply Code has been taken from Cataloging Handbook H 4-2, Code to Name.

00213 Sage Electronics Corp.
Rochester, New York

00327 Welwyn International, Inc.
Westlake, Ohio

00656 Aerovox Corp.
New Bedford, Massachusetts

00686 Film Capacitors
Passaic, New Jersey

00779 AMP Inc.
Harrisberg, Pennsylvania

01121 Allen-Bradley Co.
Milwaukee, Wisconsin

01281 TRW Semiconductors
Lawndale, California

01295 Texas Instruments, Inc.
Semiconductor Components Div.
Dallas, Texas

01686 RCL Electronics Inc.
Manchester, New Hampshire

01730 Deleted

01884 Dearborn Electronics Inc.
Orlando, Florida

02114 Ferroxcube Corp.
Saugerties, New York

02606 Replaced by 15801

02660 Amphenol-Borg Elect. Corp.
Broadview, Illinois

02799 Arco Capacitors, Inc.
Torrence, California

03508 General Electric Co.
Semiconductor Products
Syracuse, New York

03614 Replaced by 71400

03651 Replaced by 44655

03797 Eldema Corp.
Compton, California

03877 Transitron Electronic Corp.
Wakefield, Massachusetts

03888 Pyrofilm Resistor Co., Inc.
Cedar Knolls, New Jersey

03911 Clairex Corp.
New York, New York

03980 Muirhead Instruments, Inc.
Mountainside, New Jersey

04009 Arrow Hart and Hegemen
Electronic Company
Hartford, Connecticut

04062 Replaced by 72136

04202 Replaced by 81312

04217 Essex Wire Corp.
Wire & Cable Div.
Anaheim, California

04221 Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222 Aerovox Corp. (H-Q)
Myrtle Beach, South Carolina

04645 Replaced by 75376

04713 Motorola Semiconductor Products Inc.
Phoenix, Arizona

05082 Replaced by 94154

05236 Jonathan Mfg. Co.
Fullerton, California

05277 Westinghouse Electric Corp.
Semiconductor Dept.
Youngwood, Pennsylvania

05278 Replaced by 43543

05397 Union Carbide Corp.
Electronics Div.
Cleveland, Ohio

05279 Southwest Machine & Plastic Co.
Los Angeles, California

05397 Union Carbide Corp.
Electronics Div.
New York, New York

05571 Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574 Viking Industries
Chaisworth, California

05704 Alac, Inc.
Glendale, California

05820 Wakefield Engineering Ind.
Wakefield, Massachusetts

06001 General Electric Company
Capacitor Department
Irmo, South Carolina

06136 Replaced by 63743

06473 Amphenol Space & Missile Sys.
Chatsworth, California

06555 Beede Electrical Instrument Co.
Penacook, New Hampshire

06739 Electron Corp.
Littletown, Colorado

06743 Clevite Corp.
Cleveland, Ohio

06751 Semcor Div., Components, Inc.
Phoenix, Arizona

06860 Gould National Batteries Inc.
City of Industry, California

06980 Varian-Eimac
San Carlos, California

07115 Replaced by 14674

07138 Westinghouse Electric
Corp., Electronic
Tube Division
Elmira, New York

07256 Silicon Transistor Corp.
Garden City, New York

07263 Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344 Bircher Co., Inc.
Rochester, New York

07792 Lerma Engineering Corp.
Northampton, Massachusetts

07910 Teledyne Corp.
(Continental Device)
Hawthorne, California

08225 Industro Transistor Corp.
Long Island City, New York

08530 Reliance Mica Corp.
Brooklyn, New York

08792 Discontinued

08806 General Electric Co.
Miniature Lamp Dept.
Cleveland, Ohio

08863 Nylomatic Corp.
Norrisville, Pennsylvania

08988 Skottie Electronics Inc.
Archbald, Pennsylvania

09353 C and K Components
Watertown, Massachusetts

09423 Scientific Components, Inc.
Santa Barbara, California

09922 Burndy Corp.
Norwalk, Connecticut

11236 CTS of Berne
Berne, Indiana

11237 Chicago Telephone of
Calif., Inc. (CTC)
Paso Robles, California

11358 Discontinued

11403 Best Products Co
Chicago, Illinois

11503 Keystone Mfg.
Div. of Avis Industrial Corp.
Warren, Michigan

11726 Qualidyne Corp.
Santa Clara, California

12014 Chicago Rivet & Machine Co.
Bellwood, Illinois

12040 National Semiconductor Corp.
Danburry, Connecticut

12060 Diodes, Inc.
Chatsworth, California

12136 Philadelphia Handle Co.
Camden, New Jersey

12333 Presm Co., Inc.
Shelton, Connecticut

12[illegible] Freeway Washer & Stamping Co.
Cleveland, Ohio

12400 Replaced by 75042

12617 Hamlin Inc
Lake Mills, Wisconsin

12697 Clarostat Mfg. Co.
Dover, New Hampshire

12749 James Electronics
Chicago, Illinois

12856 Micrometals
Sierra Madre, California

12954 Dickson Electronics Corp
Scottsdale, Arizona

12969 Unitrode Corp.
Watertown, Massachusetts

13103 Thermalloy Co.
Dallas, Texas

13511 Amphenol Corp.
Los Gatos, California

13606 Sprague Electric Co.
Transistor Div
Concord, New Hampshire

13839 Replaced by 23732

14099 Semtech Corp
Newbury Park, California

14193 California Resistor Corp.
Santa Monica, California

14298 American Components, Inc.
Conshohocken, Pennsylvania

14655 Cornell-Dubilier Electronics
Newark, New Jersey

14674 Discontinued, see 16299

14752 Electro Cube Inc.
San Gabriel, California

14869 Replaced by 96853

15636 Elec-Trol Inc.
Northridge, California

15801 Fenwal Electronics Inc.
Framingham, Massachusetts

15818 Amelco Semiconductor
Div. of Teledyne Inc.
Mountain View, California

15849 USECO, Inc.
Mt. Vernon, New York

15908 International Business
Machines (IBM)
Essex Junction, Vermont

15909 Replaced by 17870

16299 Corning Glass
Raleigh, North Carolina

16332 Replaced by 28478

16473 Cambridge Scientific Ind, Inc.
Cambridge, Maryland

16742 Paramount Plastics
Downey, California

16758 Delco Radio
Div. of General Motors
Kokomo, Indiana

17001 ITT Cannon
Santa Ana, California

17069 Circuit Structures Lab.
Upland, California

17856 Siliconix, Inc.
Sunnyvale, California

17870 Daven-Div of Thomas A. Edison
Ind. – McGraw - Edison Co.
Manchester, New Hampshire

18083 Deleted

18178 Vactec Inc.
Maryland Heights, Missouri

18612 Vishay Intertechnology
Inc.
Malvern, Pennsylvania

18736 Voltronics Corp.
Hanover, New Jersey

19429 Discontinued, use 89536

19451 Perine Machinery & Supply Co.
Seattle, Washington

19701 Electra Mfg. Co.
Independence, Kansas

20584 Enochs Mfg. Co.
Indianapolis, Indiana

20891 Self-Organizing Systems,
Inc.
Dallas, Texas

22767 ITT Semiconductors
Div. of ITT
Palo Alto, California

23080 Product Comp. Corp.
Mount Vernon, New York

23732 Tracor
Rockville, Maryland

23880 Stanford Applied Engrng.
Santa Clara, California

23936 Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248 Southco
Div. of South Chester Corp.
Lester, Pennsylvania

24655 General Radio Co.
West Concord, Massachusetts

24759 Lenox-Fugle Electronics
Plainfield, New Jersey

25403 Amperex Electronic Corp.
Semiconductor & Receiving
Tube Division
Slatersville, Rhode Island

27014 National
Semiconductor
Corp.
Santa Clara, California

27264 Molex Products
Downers Grove, Illinois

28425 Bohannon Industries
Fort Worth, Texas

28478 Deltrol Controls,
Corp.
Milwaukee, Wisconsin

28480 Hewlett Packard
Co.
Palo Alto, California

28520 Heyman Mfg. Co.
Kenilworth, New Jersey

29083 Monsanto, Co., Inc.
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30323 Illinois Tool
Works, Inc.
Chicago, Illinois

32539 Mura Corp.
Great Neck, New York

32767 Griffith Plastic
Products Co.
Burlingame, California

32879 Advanced Mechanical
Components
Northridge, California

32897 Erie Technological
Products, Incorporated
Frequency Control Div.
Carlisle, Pennsylvania

33173 General Electric
Co., Tube Dept.
Owensboro, Kentucky

34333 Silicon General
Westminister, California

34335 Advanced Micro
Devices.
Sunnyvale, California

37942 Mallory, P. R. & Co., Inc.
Indianapolis, Indiana

42498 National Company
Melrose, Massachusetts

43543 Nytronics Inc.
Transformer Co. Div.
Alpha, New Jersey

44655 Ohmite Mfg. Co.
Skokie, Illinois

49671 Radio Corp. of America
New York, New York

49956 Raytheon Company
Lexington, Maine

53021 Sanamo Electric Co.
Springfield, Illinois

55026 Simpson Electric Company
Chicago, Illinois

56289 Sprague Electric Co.
North Adams, Massachusetts

58474 Superior Electric Co.
Bristol, Connecticut

60399 Torrington Mfg. Co.
Torrington, Connecticut

62460 Deleted

63743 Ward Leonard Electric Co.
Mount Vernon, New York

64834 West Mfg. Co.
San Francisco, California

65092 Weston Instruments Inc.
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66150 Winslow Tele-Tronics Inc.
Asbury Park, New Jersey

70563 Amperite Company
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70903 Belden Mfg. Co.
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71002 Birnbach Radio Co., Inc.
New York, New York

71236 "H.M.F.N.C.O."
Willimantic, Connecticut

71400 Bussmann Mfg.
Div. of McGraw - Edison Co.
Saint Louis, Missouri

71450 CTS Corp.
Elkhart, Indiana

71468 ITT Cannon Electric Inc.
Los Angeles, California

71482 Clare, C. P. & Co.
Chicago, Illinois

71590 Centralab
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707 Coto Coil Co., Inc.
Providence, Rhode Island

71744 Chicago Miniature Lamp Works
Chicago, Illinois

71785 Cinch Mfg. Co. & Howard
B. Jones Div.
Chicago, Illinois

72005 Driver, Wilber B., Co.
Newark, New Jersey

72092 Replaced by 06980

72136 Electro Motive Mfg. Co.
Willimantic, Connecticut

72259 Nytronics Inc.
Berkeley Heights, New Jersey

72354 Deleted

72619 Dialight Corp.
Brooklyn, New York

72653 G. C. Electronics
Rockford, Illinois

72665 Replaced by 90303

72794 Dzus Fastener Co., Inc.
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72928 Gudeman Co. (Gulton
Industries)
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72982 Erie Tech. Products Inc.
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73138 Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293 Hughes Aircraft Co.
Electron Dynamics Div.
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73445 Amperex Electronic Corp.
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73559 Carling Electric Inc.
Hartford, Connecticut

73586 Circle F Industries
Trenton, New Jersey

73734 Federal Screw Products, Inc.
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73743 Fischer Special Mfg. Co.
Cincinnati, Ohio

73899 JFD Electronics Co.
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73949 Guardian Electric Mfg. Co
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74199 Quam Nichols Co.
Chicago, Illinois

74217 Radio Switch Corp.
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74276 Signalite Inc.
Neptune, New Jersey

74306 Piezo Crystal Co.
Carlisle, Pennsylvania

74542 Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970 Johnson, E. F., Co.
Waseca, Minnesota

75042 IRC Inc. (Div. of TRW)
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75376 Kurz-Kasch, Inc.
Dayton, Ohio

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76854 Oak Mfg. Co.
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77342 Potter & Brumfield
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78189 Shakeproof
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78277 Sigma Instruments, Inc.
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78488 Stackpole Carbon Co.
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78553 Tinnerman Products
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79497 Western Rubber Company
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79963 Zierick Mfg. Corp.
New Rochelle, New York

80031 Mepco
Div. of Sessions Clock Co.
Morristown, New Jersey

80145 API Instruments Co.
Chesterland, Ohio

80183 Sprague Products
North Adams, Massachusetts

80294 Bourns Inc.
Riverside, California

80583 Hammarlund Co., Inc.
Mars Hill, North Carolina

80640 Stevens, Arnold Inc.
Boston, Massachusetts

81073 Grayhill Inc.
La Grange, Illinois

81590 Korry Mfg. Co.
Seattle, Washington

81312 Winchester Electronics
Div. of Litton Industries
Oakville, Connecticut

81439 Therm-O-Disc Inc.
Mansfield, Ohio

81483 International Rectifier Corp.
Los Angeles, California

81741 Chicago Lock Corp.
Chicago, Illinois

82305 Palmer Electronics
South Gate, California 90280

82389 Switchcraft Inc.
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82415 Price Electric Corp.
Frederick, Maryland

82872 Roanwell Corp.
New York, New York

82877 Rotron Mfg. Co., Inc.
Woodstock, New York

82879 ITT Wire & Cable Div.
Pawtucket, Rhode Island

83003 Varo Inc.
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83298 Bendix Corp.
Electric Power Division
Eatontown, New Jersey

83330 Smith, Herman H., Inc.
Brooklyn, New York

83478 Rubbercraft Corp. of America
New Haven, Connecticut

83594 Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740 Union Carbide Corp.
Consumer Products Div.
New York, New York

84171 Arco Electronics, Inc.
Great Neck, New York

84411 TRW
Ogallala, Nebraska

86577 Precision Metal Products
Stoneham, Massachusetts

86684 Radio Corp. of America
Electronic Components & Devices
Harrison, New Jersey

86689 Deleted

87034 Marco-Oak Inc.
Anaheim, California

88245 Litton Products Inc.
Van Nuys, California

88419 Use 14655

88690 Replaced by 04217

89536 Fluke, John Mfg. Co., Inc.
Seattle, Washington

89730 Replaced by 08806

90201 Mallory Capacitor Co.
Indianapolis, Indiana

90215 Best Stamp & Mfg. Co
Kansas City, Missouri

90211 Square D Co.
Chicago, Illinois

90303 Mallory Battery Co.
Tarrytown, New York

91293 Johanson Mfg. Co.
Boonton, New Jersey

91407 Replaced by 58474

91502 Associated Machine
Santa Clara, California

91506 Augat
Attleboro, Mass.

91637 Dale Electronics Inc.
Columbus, Nebraska

91662 Elco Corp.
Willow Grove, Pennsylvania

91737 Gremar Mfg Co., Inc. (ITT)
Woburn, Massachusetts

91802 Industrial Devices, Inc.
Edgewater, New Jersey

91836 King's Electronics
Tuckahoe, New York

91929 Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934 Miller Electric Co., Inc.
Pawtucket, Rhode Island

93332 Sylvania Electric Products
Semiconductor Products Div
Woburn, Massachusetts

94145 Replaced by 49956

94154 Tung-Sol
Div. of Wagner Electric Corp.
Newark, New Jersey

95146 Alco Electronics Products Inc.
Lawrence, Massachusetts

95263 Leecraft Mfg. Co.
Long Island City, New York

95264 Replaced by 98278

95275 Vitramon Inc.
Bridgeport, Connecticut

95303 Radio Corp. of America
Solid State & Receiving Tube Div.
Cincinnati, Ohio

95354 Methode Mfg. Corp.
Rolling Meadows, Illinois

95712 Dage Electric Co., Inc.
Franklin, Indiana

95987 Weckesser Co. Inc.
Chicago, Illinois

96733 San Fernando Electric Mfg. Co.
San Fernando, California

96853 Rustrak Instrument Co.
Manchester, New Hampshire

96881 Thomson Industries, Inc.
Manhasset, New York

97540 Master Mobile Mounts
Div. of Whitehall Electronics Corp.
Los Angeles, California

97913 Industrial Electronic Hdware Corp.
New York, New York

97945 White, S. S. Co.
Plastics Div.
New York, New York

97966 Replaced by 11358

98094 Replaced by 49956

98159 Rubber-Teck, Inc.
Gardena, California

98278 Microdot Inc.
Pasadena, California

98291 Sealectro Corp.
Conhex Div.
Mamaroneck, New York

98388 Accurate Rubber & Plastics
Culver City, California

98743 Replaced by 12749

98925 Deleted

99120 Plastic Capacitors, Inc.
Chicago, Illinois

99217 Southern Electronics Corp.
Burbank, California

99392 STM
Oakland, California

99515 Marshall Industries
Capacitor Div
Monrovia, California

99779 Barnes Corp.
Lansdowne, Pennsylvania

Toyo Electronics
(R-Ohm Corp.)
Irvine, California 92664

National Connector
Minneapolis, Minn. 55436

Appendix B

List of Abbreviations

alternating current	ac
ampere	A
assembly	assy
binary coded decimal	bcd
bel	B
capacitor	cap
centimeter	cm
ceramic	cer
clockwise	cw
common-mode rejection ratio	cmrr
composition	comp
counterclockwise	ccw
decibel	dB
degree Celsius	°C
degree Fahrenheit	°F
digital voltmeter	dvm
direct current	dc
electrolytic	elect
external	ext
farad	F
field effect transistor	FET
germanium	Ge
giga (10^9)	G
gigahertz	GHz
ground	gnd
guard	gd
henry	H
hertz	Hz
high frequency	hg
hour	h
inch	in
integrated circuit	IC
intermediate frequency	if
internal	intl
kilo (10^3)	k
kilohertz	kHz
kilohm	kΩ
kilovolt	kV
low frequency	lf
maximum	max
mega (10^6)	M
megahertz	MHz
megohm	MΩ
meter	m
micro (10^{-6})	μ
microsecond	μs
milli (10^{-3})	m
milliamperes	mA
millimeter	mm
millisecond	ms
millivolt	mV
minimum	min
nano (10^{-9})	n
nanosecond	ns
negative	neg
ohm	Ω
oscilloscope	scope
parts per million	ppm
peak-to-peak	p-p
pico (10^{-12})	p
picofarad	pF
plus or minus	±
positive	pos
plastic	plstc
printed circuit board	pcb
radio frequency	rf
root mean square	rms
second (time)	s
serial number	SN
silicon	Si
tantalum	Ta
temperature coefficient	TC
tera (10^{12})	T
transformer	xfmr
transistor	xstr
ultra high frequency	uhf
variable	var
very high frequency	vhf
very low frequency	vlf
volt	V
voltage controlled oscillator	vco
watt	W
wirewound	ww

Appendix C

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5616 4th Ave. South
Tel. (206) 762-2310
Zip 98108

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7329 E. Stetson Dr.
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Scottsdale, AZ 85251

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Instrument Specialists, Inc.
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Glendale, California 91204
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Zip 95050

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4805 Mercury St., Ste. 1
Tel. (714) 565-2555
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Instrument Representatives, Inc.
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940 N. Fern Creek Ave.
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Industrial Electronics, Inc.
646 Queen Street
P.O. Box 135
Tel. (808) 533-6095
Zip 96817

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Cozzens & Cudahy, Inc.
1301 N. Rand Rd.
Des Plaines, IL 60016
Tel. (312) 298-3600

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21 Beachway Drive
Tel. (317) 244-2456
Zip 46224

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11501 Huff Court
Kensington, Maryland 20795
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BOSTON
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109 Massachusetts Ave.
Lexington, MA 02173
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MICHIGAN

DETROIT
WKM Associates, Inc.
1474 East Outer Dr.
Tel. (313) 892-2500
Zip 48234

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MINNEAPOLIS
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10800 Lyndale Ave. S.
Tel. (612) 884-4336
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Tel. (314) 423-1234

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Zip 27408

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WKM Associates, Inc.
16141 Puritas Ave.
Tel. (216) 267-0445
Zip 44135

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WKM Associates, Inc.
6073 Far Hills Ave.
Tel. (513) 434-7500
Zip 45459

PENNSYLVANIA

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210 Goddard Blvd., Ste. 100
King of Prussia, Pennsylvania
Tel. (215) 248-5050
Zip 19406

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90 Clairton Blvd.
Tel. (412) 892-2953
Zip 15236

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Suite 220
312 N. Central Express Wy.
Richardson, Texas 75080
Tel. (214) 231-2573

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3810 Westheimer
Tel. (713) 621-0040
Zip 77027

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Zip 98108

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6427 Northam Drive
Tel. (416) 678-1500

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376 Churchill Ave., Suite 106
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QUEBEC

LONGUEUIL
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Virrey del Pino 4071
Buenos Aires, Argentina

AUSTRALIA
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AUSTRIA
Kontron GMBH & Co., Kg.
Lederergasse 16
1080 Vienna, Austria

BELGIUM
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37 Place de Jamblinne de Meux
1040 Brussels, Belgium

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ZC - 29
Rio de Janeiro GB, Brazil

Ambriex S.A.
Rua Tupi, 535
01233 Sao Paulo SP, Brazil

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Casilla 14588 - Correo 15
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May Lee Industries, Inc.
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New York, N.Y. 10016

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Apartado Aereo 90687
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Apartado 228A
Quito, Ecuador

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Oy Findip AB
P.O. Box 25
00521 Helsinki 52, Finland

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M.B. Electroniques S.A.
29, Rue Emile Duclaux
92, Suresnes
France

GERMANY
Fey Elektronische Messgerate
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Horemansstrasse 28
West Germany

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Athens 19 Greece

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P.O. Box 56
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Bombay-6 India

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20 Salm Road, Roosevelt Ave.
Tehran, Iran

ISRAEL
R.D.T. Electronics Engineering Ltd.
19 Prof. Shor Street
Tel-Aviv, Israel

ITALY
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Rome, Italy

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P.O. Box 5014
Tokyo International
Tokyo 100-31, Japan

Suzuki Bldg.
2-38 Junkeicho-dori
Minami-ku, Osaka

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Internaltion P.O. Box 1250
Seoul, Korea

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O'Connor's (Pte) Ltd.
P.O. Box 1197
Kota Kinabalu
East Malaysia

P.O. Box 91
Petaling Jaya, Selangor
West Malaysia

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Eugenia 408
Departments 1 y 5
Mexico 12, D.F.
Mexico

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13 - Cort van der Lindenstraat
Rijswijk (Z.H.) 2100
Netherlands

Fluke (Nederland) B.V.
Ledeboerstraat 27
Industrieterrein Noord
Tilburg, Netherlands

NEW ZEALAND
David J. Reid (N.Z.) Ltd.
C.P.O Box 2630
Auckland 1, New Zealand

NIGERIA
Deemtee Electrotechnics Ltd.
P.O. Box 3073
Lagos, Nigeria

NORWAY
Morgenstierne & Co. A/S
P.O. Box 6688 Rodeløkka
Oslo 5, Norway

PAKISTAN
Pak International Operations
505 Muhammadi House-McLeod Rd.
P.O. Box 5323
Karachi, Pakistan

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Importaciones y Representaciones Electronicas S.A.
Avda. Frankiln D. Roosevelt 105
Lima 1, Peru

PORTUGAL
Equipamentos De Laboratorio, Lda.
P.O. Box 1100
Lisbon, Portugal

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O'Connor's (Pte) Ltd.
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Singapore 5, Singapore

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Teleinstrument AB
P.O. Box 490
S-16204 Vallingby
Sweden

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Kontron Electronic A.G.
Bernerstrasse Sud 169
8048 Zurich
Switzerland

TAIWAN-REPUBLIC OF CHINA
Heighten Trading Company, Ltd.
P.O. Box 1408
Taipei, Taiwan 104

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Suriwong
Bangkok, Thailand

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Garnett Close
Watford, WD2 4TT
England

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Cerrito 617 - 4º Pisco
Montevideo, Uruguay

U.S.S.R.
Codevintec Pacific Inc.
6263 Variel
Woodland Hills, Calif. 91364

VENEZUELA
Coasin C.A.
Apdo. Postal 50939
Sabana Grande No.1
Caracas 105
Venezuela

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Rev. 5/73

Section 7

Schematic Diagrams

SCHEMATIC DIAGRAMS 7-1
1941A-1001 TROUBLESHOOTING 7-2
1941A-1001 MAIN PCB AND WIRING, SCHEMATIC 7-3
1941A-1002 TROUBLESHOOTING 7-4
1941A-1002 DISPLAY PCB, BCD OUTPUT AND BCD PRESET SCHEMATIC 7-5

Counter Conditions: Select the 0.1s pushbutton.

Apply a 40mV, 500 kHz signal to the counter input.

Results (No. 1): Does the counter properly display the frequency of the input signal? YES ☐ NO ☐

Counter Conditions: Select the TOTALIZE pushbutton.

Apply a 40 mV 10 Hz signal to the counter input.

Results (No. 2): Is the counter display counting at a 10 Hz rate? YES ☐ NO ☐

Counter Conditions: Place the CLOCK INT EXT selector switch in the EXT position.

Apply a 10 MHz external clock signal to the CLOCK INPUT 10 MHz jack.

Select the 0.1s pushbutton.

Apply a 40 mV, 500 kHz signal to the counter input.

Results (No. 3): Does the counter properly display the frequency of the input signal? YES ☐ NO ☐

Make the connections indicated for each operating condition and observe the counter display for the indicated results 1, 2 and 3. Use the test equipment recommended in Table 4-1.

RESULTS	ANSWER SET 1	ANSWER SET 2	ANSWER SET 3
No. 1	NO	NO	NO
No. 2	NO	YES	YES
No. 3	NO	YES	NO

ANSWER Set 1: Perform the power supply checks then the input amplifier checks

ANSWER Set 2: Perform the clock checks

ANSWER Set 3: Perform the program logic checks.

Power Supply Checks

Using a voltmeter check the 5, 10 and 170 volt power supplies. Supplies should be as follows:

5 volt supply	5 volts ±0.25 volts
10 volt supply	10 volts ±0.5 volts
170 volt supply	190 volts ±10 volts

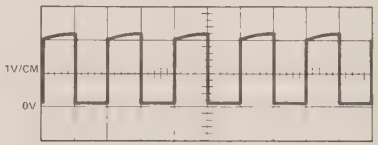
Hints:

1. The loss of the +5 volt supply will cause the display tubes to have a hazy red glow without displaying digits.

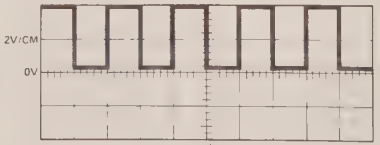
Input Amplifier Checks:

Apply a 500 kHz 40mV signal to the counter input. Select the 0.1s pushbutton, and insure the filter and attenuator pushbutton are released. Using an oscilloscope, make the following checks:

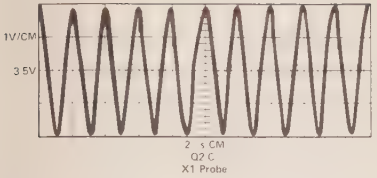
U2, Pin 3



Q3 Collector



Q2 Collector



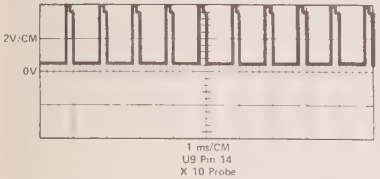
Hints:

1. If the counter does not display the above wave forms with a 40 mV input signal try increasing the input signal level to 500 mV.

Program Logic Checks

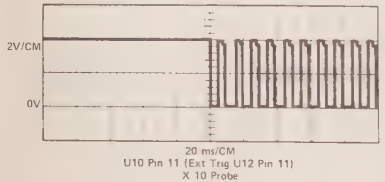
Using an oscilloscope make the following checks in the program logic. The 1941A does not need a signal applied to the input for the program logic checks.

U9, Pin 14



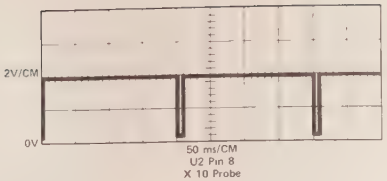
If the scope display is not as shown proceed to the clock checks.

U10, Pin 11

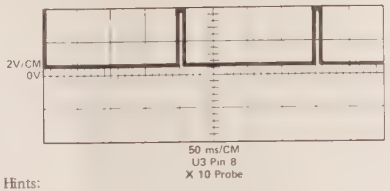


Connect the oscilloscope external trigger to U12, pin 11.

U2, pin 8



U3, pin 8



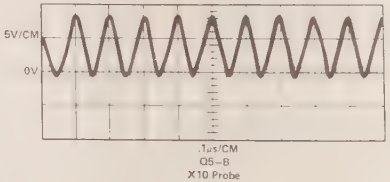
Hints:

1. U3 pins 9 and 12 should always be at logic 1 (approximately +3.5v) except when the manual reset button is held in.

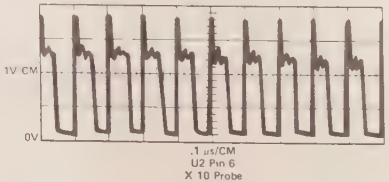
Clock Checks

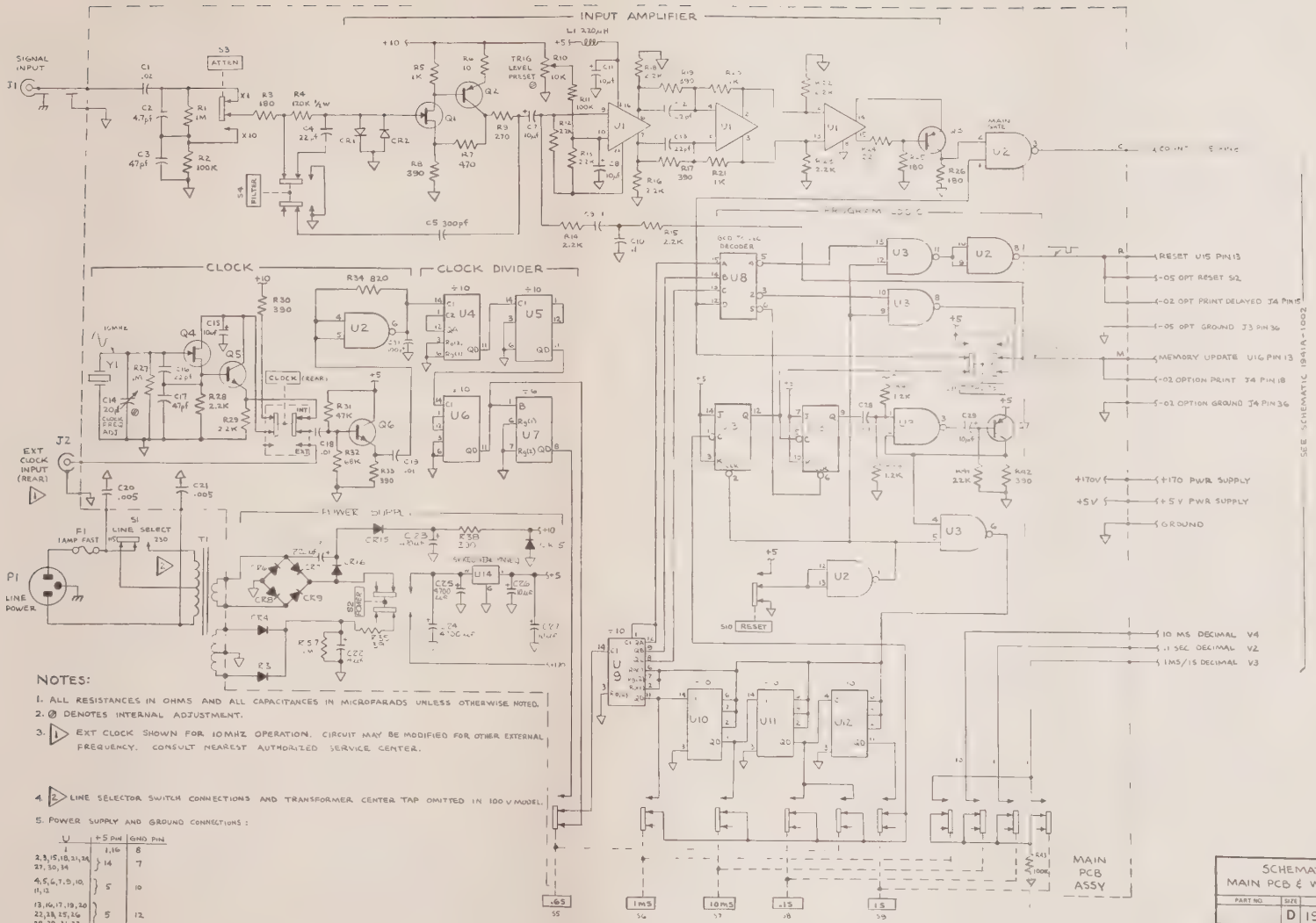
The clock "checks" not only check the operation of the internal clock, but the clock divider as well. A malfunction in the clock divider will cause improper operation of the counter using either an internal or external clock.

Q5 Base



U2, pin 6





NOTES:

1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCES IN MICROFARADS UNLESS OTHERWISE NOTED.
2. Ø DENOTES INTERNAL ADJUSTMENT.
3. ▷1 EXT CLOCK SHOWN FOR 10MHZ OPERATION. CIRCUIT MAY BE MODIFIED FOR OTHER EXTERNAL FREQUENCY. CONSULT NEAREST AUTHORIZED SERVICE CENTER.
4. ▷2 LINE SELECTOR SWITCH CONNECTIONS AND TRANSFORMER CENTER TAP OMITTED IN 100 V MODEL.
5. POWER SUPPLY AND GROUND CONNECTIONS:

U	+5 PIN	GND PIN
1	1,16	8
2,3,15,18,21,26 27,30,34	14	7
4,5,6,7,9,10, 11,12	5	10
13,16,17,19,20 22,23,25,26 28,29,31,32	5	12
8	16	8

SCHEMATIC MAIN PCB & WIRING		
PART NO.	SIZE	DRAWING NO.
	D	1941A-1001
SCALE	SHT 1 OF 1	REV. C

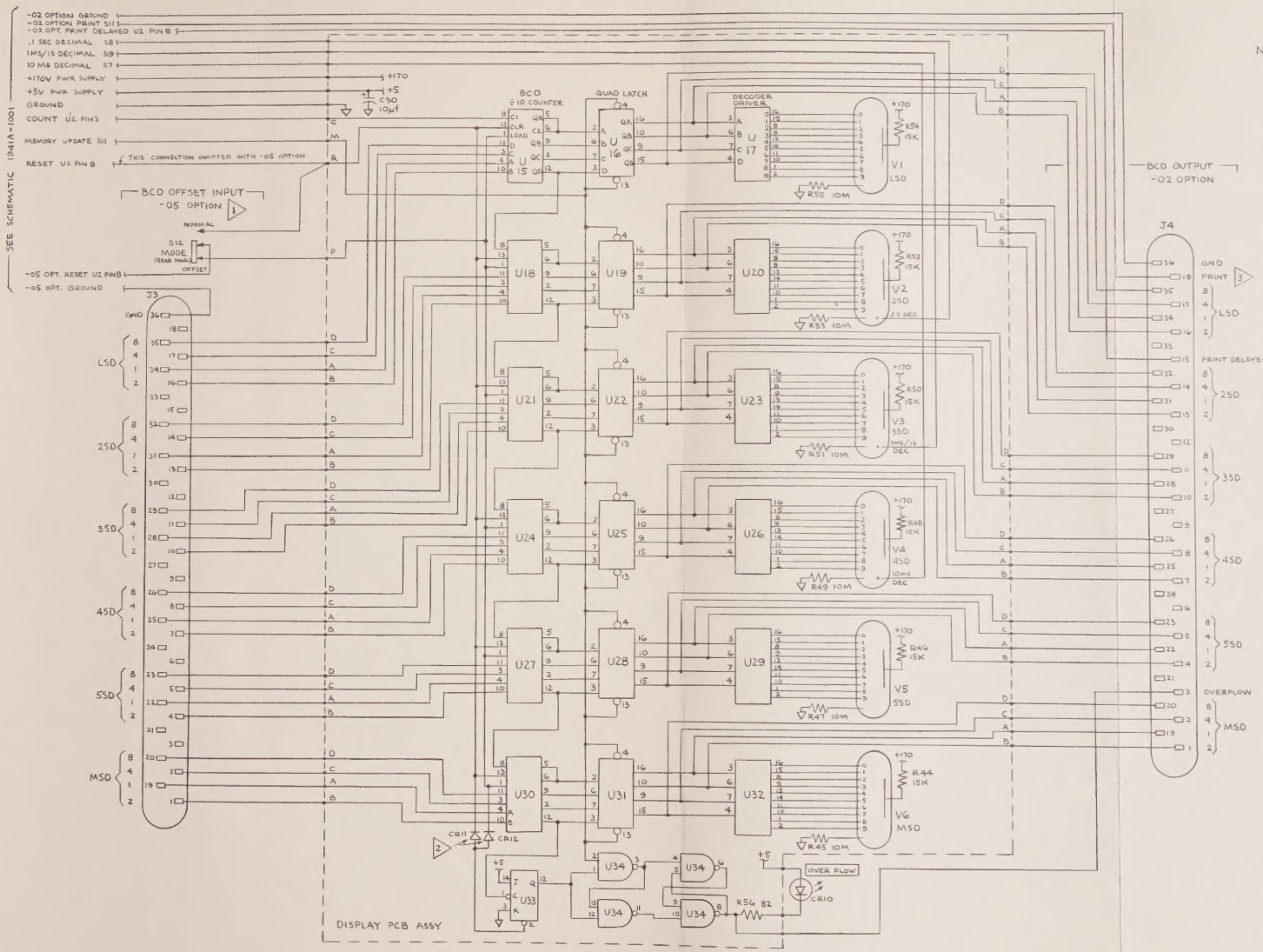
Count and Display

Most malfunctions in the count and display circuits can be recognized by the improper counter display they cause. A malfunction in one quad latch or decoder driver would cause only the associated display tube to exhibit an error. If successive display tubes present erroneous data, the probable cause is the BCD counter of the least significant digit displaying the error.

The count and display circuit processes the square wave output of U2 pin 3 at approximately the same voltage levels. The counting process for each digit can be observed using an oscilloscope, at the input (pin 8) of each BCD counter. The bcd equivalent of each displayed digit should be present at the output (pins 16, 10, 9 and 15) of the corresponding quad latch. For example; if display tube V2 displayed a "7", the output pins of quad latch U19 should be as follows:

Pin 16	–	Logic 1
Pin 10	–	Logic 1
Pin 9	–	Logic 1
Pin 15	–	Logic 0

Logic 1	=	>2.0 VDC
Logic 0	=	<+0.5 VDC



NOTES:

1) 1 BCD OFFSET INPUT RESPONDS AS FOLLOWS: LINES CORRESPONDING TO NUMBER CALLED MUST BE HIGH OR FLOAT. ALL OTHER LINES TO SAME DIGIT MUST BE LOW OR GND.

2) 2 CR11 & CR12 INSTALLED WITH -05 OPTION ONLY.

3) 3 PRINT SIGNAL (PIN 18) IS POSITIVE GOING. PRINT DELAYED SIGNAL (PIN 15) IS NEGATIVE GOING DELAYED FROM PRINT SIGNAL.

CHANGE DESCRIPTION	DR	CHK	APPR

SCHEMATIC
DISPLAY PCB, BCD OUTPUT & BCD OFFSET INPUT OPTIONS

PART NO.	SIZE	DRAWING NO.
	D	1941A-1002
SCALE NONE	SHT 1 OF 1	REV

7-5/7-6

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